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RAPID ASSESSMENT REPORT FOR SITE 27 BUILDING 221 ZONE E WITH TRANSMITTAL

CNC CHARLESTON SC

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TETRA TECH

Rev.1
03/05/00

Rapid Assessment Report for Site 27, Building 221

Zone E
Charleston Naval Complex
North Charleston, South Carolina

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0089

March 2000

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TTNUS/TAL-00-025/0126/3.2

March 09, 2000

Project Number 0126

Mr. Paul Bristol
South Carolina Department of Health and Environmental Control
Groundwater Quality Section
Bureau of Water
2600 Bull Street
Columbia, South Carolina 29201-1708

Reference: Clean Contract No. N62467-94-D0888
Contract Task Order No. 0089

Subject: Final Rapid Assessment Report for
Site 27, Building 221
Charleston Naval Complex
Charleston, South Carolina

Dear Mr. Bristol:

On behalf of the Department of the Navy, Southern Division, Naval Facilities Engineering Command, Tetra Tech NUS, Inc. is pleased to submit the Final Rapid Assessment Report for the referenced site at the Charleston Naval Complex.

If you have any questions regarding this plan or require further information, please contact me at (850) 385-9899.

Very truly yours,

Paul E. Calligan, P.G.
Task Order Manager

PC/dd

Enclosures (2)

c: Mr. Gabriel Magwood, SOUTHDIV
Ms. D. Wroblewski (Cover Letter Only)
Mr. M. Perry/File (Unbound)

RAPID ASSESSMENT REPORT
FOR
SITE 27, BUILDING 221

ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0089

March 2000

PREPARED UNDER THE SUPERVISION OF:

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CERTIFICATION PAGE

I certify that the information contained in this report and on any attachments is true, accurate, and complete to the best of my knowledge, information, and belief.

Approved By: Gregory D. Swanson 1/27/00

Gregory D. Swanson, P.E.
South Carolina Registration No. 17132
SCDHEC UST Site Rehabilitation Contractor Class I & II No. 24

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EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (TtNUS) has completed a Rapid Assessment (RA) for Site 27 which formerly contained an underground storage tank (UST) system located adjacent to Building 221 at the Charleston Naval Complex (CNC), Zone E in Charleston, South Carolina. The UST (UST 221-1 or UST 221), a 280-gallon steel constructed tank, was a gravity fed holding tank used to store waste oil as part of an oil/water separator system located at Building 221. The RA was performed under the direction of the South Carolina Department of Health and Environmental Control's (SCDHEC's) Rapid Assessment Plan and approval letter dated November 4, 1998.

TtNUS performed the following actions during this assessment:

- Reviewed available Navy documents to identify potential sources and receptors for petroleum hydrocarbons in the vicinity, to evaluate public and private potable wells, to locate utilities line areas, to locate nearby surface water bodies, and to determine surface hydrology and drainage;
- Reviewed the previously prepared Underground Storage Tank Assessment Report for UST 221 to determine boring locations and monitoring well placements;
- Conducted a site survey to identify utilities and to construct a site plan;
- Performed direct push technology (DPT) investigation; field screened 7 soil samples for organic vapors using an organic vapor analyzer equipped with a flame ionization detector;
- Collected soil samples from one DPT boring for mobile lab screening analysis for benzene, toluene, ethylbenzene, total xylenes (BTEX), naphthalene, and diesel range organics (DRO) using U.S. Environmental Protection Agency (USEPA) Method 8020/8015M;
- Collected groundwater samples from seven DPT borings for mobile lab screening analysis for BTEX, naphthalene, and DRO using USEPA Method 8020/8015M;
- Used five existing shallow monitoring wells located at the site to determine the relative groundwater flow direction;
- Installed one permanent shallow monitoring well to a depth of approximately 12 feet below land surface (bls);
- Collected one soil sample for fixed-base laboratory analysis for BTEX and naphthalene using USEPA Method 8260, polynuclear aromatic hydrocarbons (PAHs) using USEPA Method 8270, total organic carbon (TOC) using USEPA Method 9060, total recoverable petroleum hydrocarbon (TRPH) using USEPA Method 9071A, and grain size analysis using American Society of Testing and Materials (ASTM) Method C-117 and C-136;

- Collected groundwater samples from the one newly installed shallow well, four existing shallow wells, and one deep well (including one duplicate sample) for fixed-base laboratory analysis for BTEX, methyl tertiary butyl ether (MTBE), ethylene dibromide (EDB or 1,2-dibromoethane), naphthalene using USEPA Method 8260, PAHs using USEPA Method 8270, eight specific metals (lead, arsenic, barium, cadmium, chromium, mercury, selenium, and silver)
- Collected groundwater samples from three wells for natural attenuation parameters analyzed in the field and in a fixed-base laboratory;
- Surveyed the top of casing elevations for each monitoring well and collected depth to groundwater measurements to confirm the groundwater flow direction.

Conclusion

On October 12, 1999, one soil sample was collected and analyzed at a fixed base laboratory for BTEX, MTBE, EDB, naphthalene, PAHs, metals, total organic carbon, total recoverable petroleum hydrocarbons, and grain size analysis. None of the constituents analyzed were detected.

On September 23, 1999, depth to groundwater measurements were recorded from the site monitoring wells (five existing wells and one new well). Based on the calculated water table elevations from each well, groundwater flow at the site is divided. Groundwater beneath the former UST-221 flows to the southeast, towards the Cooper River. Approximately 10 to 15 feet northwest of former UST-221, groundwater flows to the northwest, away from the Cooper River. The northwest groundwater flow direction may be the result of influence by a storm drain utility line located between buildings 221 and 56. However, the influence on the water table from the storm drain utility line was not investigated further during this assessment. No free product was detected in any existing or new monitoring well at the site during this assessment.

On September 23, 1999, seven groundwater samples (including one duplicate) were collected and analyzed at a fixed base laboratory for BTEX, MTBE, EDB, naphthalene, PAHs, metals. In addition, groundwater samples were collected from three wells and analyzed for the following natural attenuation parameters: dissolved oxygen, alkalinity, carbon dioxide, manganese, ferrous iron, nitrite, sulfide, nitrogen/nitrate, sulfate and methane. Nitrogen/nitrate, sulfate, and methane were analyzed in a fixed base laboratory, but the remaining natural attenuation parameters were analyzed in the field at the time of sample collection. No BTEX constituents, MTBE, or PAHs, with the exception of naphthalene, were detected in any of the groundwater samples. Naphthalene was detected at a concentration exceeding its RBSL in one groundwater sample.

Lead (Pb) was detected at concentrations exceeding it's RBSL in three groundwater samples; one was a duplicate sample. Total chromium was detected at a concentration exceeding its RBSL in one sample. No other constituents analyzed were detected in the groundwater samples, including the deep, vertical delineation well (existing well CNC27X-04D).

The vertical and horizontal extent of petroleum hydrocarbon impact to soil and groundwater in the vicinity of the former UST system at Building 221 has been delineated.

The Site Conceptual Model identified two possible future receptors: a construction worker in a utility trench and the Cooper River. Pathways for the construction worker include (1) possibly ingesting, having dermal contact with, or inhaling volatilized vapors from the groundwater in the utility trench, and (2) possibly ingesting or having dermal contact with soil within the trench. The pathway for the Cooper River is groundwater migration to the river from the site.

The minimum RBSL for naphthalene and chromium are greater than the greatest onsite concentration of each CoC detected in site groundwater. Therefore, a construction worker in a utility trench exposed to groundwater containing naphthalene and/or chromium from Site 27 is not at risk from exposure. However, the construction worker is at risk if exposed to lead in the groundwater. The current concentrations of naphthalene, lead, and total chromium in monitoring well CNC27X-03 are below the calculated SSTLs for affecting the Cooper River. Therefore, the Cooper River is not at risk because of the naphthalene, lead, and total chromium concentrations in groundwater at the site.

The maximum concentrations for naphthalene and chromium found onsite are less than the respective minimum SSTLs, therefore, naphthalene and chromium in groundwater do not pose a threat to the identified receptors at the site. However, the maximum concentration for lead found on site exceeds it's the minimum SSTL, therefore, lead in groundwater poses a threat to a construction worker in a utility trench exposed to groundwater.

Recommendation

Because concentrations for lead in groundwater exceed the minimum SSTL protective of a construction worker in a utility trench, Tetra Tech NUS, Inc. recommends preparing an Active Corrective Action Plan.

1.0 INTRODUCTION

Site 27 formerly contained an underground storage tank (UST) system located adjacent to Building 221 at the Charleston Naval Complex (CNC), Zone E in Charleston, South Carolina. The UST (UST 221-1 or UST 221), a 280-gallon steel constructed tank, was a gravity fed holding tank used to store waste oil as part of an oil/water separator system located at Building 221. This Rapid Assessment (RA) was performed by Tetra Tech NUS, Inc.'s (TtNUS's) Tallahassee, Florida, office, located at 1401 Oven Park Drive, Suite 102, Tallahassee, Florida 32312 (telephone number 850-385-9899) on behalf of the U.S. Navy Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC), 2155 Eagle Drive, North Charleston, South Carolina (telephone number 843-820-7307). Authorization to conduct the RA for the site was issued by NAVFAC under Contract Task Order (CTO) 0068. The RA was performed under the direction of the South Carolina Department of Health and Environmental Control's (SCDHEC's) Rapid Assessment Plan approval letter dated November 4, 1998. Fieldwork necessary to complete the RA was performed from May to October 1999, and was interrupted twice during this period due to approaching hurricanes (Dennis and Floyd.)

1.1 SITE DESCRIPTION

The CNC is in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina, as shown on Figure 1. This installation consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bound on the west by the Ashley River and on the east by the Cooper River. The site is located within the developed portion of the base as shown on Figure 1.

The area surrounding CNC is "mature urban," having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. A site vicinity map, which exhibits adjacent properties and structures, vicinity roads, current utilities, and vicinity surface drainage, is included as Figure 2.

Building 221 is a former pickling plant and galvanizing shop located inside the Controlled Industrial Area (CIA) of the Charleston Naval Shipyard (now known as the CNC). Building 221 was part of Building 56, the Pipe Shop Area. The oil/water separator and tank system at Building 221 site was part of a steam-cleaning pad. The pad was used for cleaning oily and/or greasy parts and components. A small catch basin in the pad drained into the oil/water separator. In 1983-1984, the operation was shut down. The site is currently situated approximately 200 feet from the Cooper River [Supervisor of Ship Building,

Conversion and Repair, United States Navy, Portsmouth, Virginia, Environmental Detachment Charleston (SPORTENDETCHASN), 1998].

1.2 SITE HISTORY

In 1901, the U.S. Navy acquired 2,250 acres near Charleston to build a shipyard and the first naval officer was assigned duty in early 1902. Subsequently, buildings and a dry dock were constructed in the Naval Yard. The dry dock was completed in 1909 along with several other brick buildings and the main power plant, which is still in operation today. The first ship was placed in dry dock and work began on fleet vessels in 1910. World War I brought about an expansion of the yards, facilities, land area, and work force. The yard built two gunboats, several submarine chasers, and tugs in addition to performing repairs and other services to the fleet. In 1933, building activity had increased principally in construction of several Coast Guard tugs, a Coast Guard cutter, and a Navy gunboat, creating the need for more facilities and a much larger work force. In 1943 civilian work force peaked with almost 26,000 employees divided among three daily shifts. In 1956, construction began on piers, barracks, and buildings for mine warfare ships and personnel. Later in the decade, the facility became a major homeport for combatant ships and submarines of the U.S. Atlantic Fleet [Ensafe/Allan & Hoshall, Inc. (E/A&H), 1996].

In 1993, major cuts in defense spending, as a result in part to the end of the cold war, caused CNC to be added to the list of bases scheduled for closure under the Defense Base Realignment and Closure Act (BRAC). BRAC regulates the closure and transition of property back to the community (E/A&H, 1996). With the scheduled closure of the base, operations were scaled back and environmental cleanup proceeded to make the property available for redevelopment after closure. As part of the environmental cleanup process, the UST at Building 221 was removed and the tank closure completed on June 18, 1996.

Between June 14 and 18, 1996, UST 221 was removed, cleaned, and recycled as scrap metal. At the time of the UST removal, no corrosion, pitting, or holes were found in the tank. The UST system piping was constructed of steel and ran from the UST to the separator. The piping from the vault to the building was removed during the closure. The pipes were mildly corroded, but overall, were considered to be in good condition. However, the pipe feed from the separator to the UST had a loose mechanical connection at the UST (SPORTENDETCHASN, 1998).

During the removal of the tank, no petroleum contamination or odors were identified in excavated soils or in the soil samples collected during the tank removal. The Underground Storage Tank Assessment Report for UST 221 is included in Appendix A.

1.3 RECEPTOR SURVEY RESULTS

A survey of the site vicinity was conducted by TtNUS personnel to identify potential receptors for petroleum hydrocarbon contamination. The site plan (Figure 2) depicts the public utilities located within 250 feet of the former UST 221 study area. Specific information concerning the depth of utilities below land surface is currently unavailable. However, according to facility personnel, utility lines are typically located approximately 2 to 6 feet below land surface (bls) (SPORTENVDETCHASN, 1999). The following utility receptors were located:

- Sanitary Sewer: A main sanitary sewer line is located north of Building 221, beneath Second Street. The main line extends from the southwest, at the intersection of Second Street and Avenue B, to the northeast, to the intersection of Second Street and Roe Avenue. This main line then extends southeast towards Pier "C", then bends 90 degrees to the southwest running to the south of Building 221. The sanitary sewer line from Building 221 ties into the main line from the north side of the building.

- Water Utility: A potable water utility line is located to the north, west, and south of Building 221. A water line is also located to the east, next to Building 74, which is immediately adjacent to and east of Building 221. The water utility line for Building 221 ties into the main distribution line from the north side of the building.

- Electrical Utility: An electrical utility line is located to the north and south of Building 221. An electrical line is also located to the east, next to Building 74, which is immediately adjacent to and east of Building 221. The electrical utility line for Building 221 ties into the main distribution line from the northeast corner of the building.

- Storm Drain Utility: A storm drain line is located to the north, west and east of Building 221. The storm drain lines to the east of Building 221 are located between Buildings 221 and 74 and east of Building 74. Building 74 is located east of and immediately adjacent to Building 221. Based on the utilities shown in Figure 2, it appears that a storm drain line originates from Building 221 carrying runoff water draining from the east side of the building extending north to the main distribution line.

- Compressed Air Utility: A compressed air line is located to the north and south of Building 221. The compressed air line does not extend to Building 221.

- Steam Utility: A steam line is located to the north and south of Building 221. A steam line is also located to the east, next to Building 74, which is immediately adjacent to and east of Building 221. The steam line for Building 221 ties into the main distribution line from the south of the building.

- Gas Utility: No gas utility lines are shown in Figure 2, nor was any line identified in the field.

A survey of groundwater users within a 7-mile radius of CNC was performed for the Final RCRA Facility Investigation Report for Zone E (E/A&H, 1996). According to this report, a survey of groundwater users within a 7-mile radius of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no drinking water wells, which utilize the shallow aquifer, are located within a 4-mile radius of CNC. Irrigation wells were not identified within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to UST 221 is in Pier "C" located on the Cooper River, approximately 150 feet to the south.

There are no city, county, or state zoning ordinances, as the federal government currently owns the property. Information concerning zoning ordinances was obtained from the SOUTHDIV Remedial Project Manager (Mr. Gabriel Magwood) located at 2155 Eagle Drive, North Charleston, South Carolina (telephone number 843-820-7307).

1.4 REGIONAL GEOLOGY AND HYDROGEOLOGY

CNC is located in Charleston County, South Carolina, in the Lower South Carolina Coastal Plain Physiographic Province on the Cooper River side of the Charleston Peninsula. The peninsula is formed by the confluence of the Cooper and Ashley Rivers. Topography in the area is typical of the South Carolina lower coastal plain and is characterized by having low-relief plains broken by the meandering streams and rivers, flowing toward the coast past occasional marine terrace escarpments (E/A&H, 1996).

The geology of the Charleston area is typical of the southern Atlantic Coastal Plain. Cretaceous-age and younger sediments thicken seaward and are underlain by older igneous and metamorphic basement rock. Surface exposures consist of recent or Pleistocene sands, silts, and clays of high organic content referred to as the Wando Formation (E/A&H, 1996). Underlying the Wando Formation, increasing with age, are the Oligocene-age Cooper Group and the Eocene–age Santee Limestone. The Cooper Group is comprised of the Ashley, Parkers Ferry, and Harleyville Formations. The formation of particular importance in the Cooper Group is the Ashley Formation, which was formerly referred to as the Cooper Marl in most regional geologic literature. In more recent geologic nomenclature, the name "Cooper" has been given to a group of formations including the Ashley Formation, a pale green to olive-brown, sandy

phosphoric limestone or marl, which is locally muddy and/or sandy. The Ashley Formation in the vicinity of Charleston is encountered at a depth of approximately 30 to 70 feet bls. The top of the Ashley Formation has been reported to be associated with an erosional basin and the entire Cooper Unit, including the Ashley Formation, is indicated to be approximately 300 feet thick (E/A&H, 1996).

Groundwater occurs under water table or poorly confined conditions within the recent or Pleistocene deposits overlying the Ashley Formation of the Cooper Group. Transmissivity in the Pleistocene aquifer is generally less than 1,000 feet per day and well yields are variable, ranging from 0 to 200 gallons per minute (gpm). This groundwater contains high concentrations of iron and is commonly acidic at shallow depths (E/A&H, 1996).

The Cooper Group is hydrogeologically significant mainly because of its low permeability. In most locales, its sandy, finely granular limestone produces little or no water, but instead acts as confining material causing artesian conditions in the underlying Santee Limestone. Yields from wells in the Santee are usually less than 300 gpm (E/A&H, 1996).

2.0 ASSESSMENT INFORMATION

2.1 SITE-SPECIFIC GEOLOGY AND HYDROGEOLOGY

2.1.1 Site Geology

Seven direct push soil borings (CNC27-B01 through CNC27-B07) were advanced at Site 27 under the supervision of a TtNUS geologist between May 26 and July 8, 1999, as shown in Figure 3. These borings were constructed from land surface to a maximum depth of 8 feet bls and provided soil samples to characterize the subsurface lithology. On August 4, 1999, one shallow monitoring wells (CNC27-M01) was installed to a depth of 12 feet bls. During installation grab soil samples were collected to describe the subsurface lithology. Since five wells at the site were installed as part of previous activities, these wells were used in this assessment. The previous well identification numbers, TtNUS's existing well identification numbers, and the locations of each existing well and new well are shown in Figure 4.

Based on lithologic descriptions from the soil borings and monitoring well, the subsurface soil generally consists of interlayers of light brown to dark brown to grey colored silty sand, silty clay, and sandy clay near the surface to a depth of approximately 12 feet bls (see Figures 5, 6, and 7). Boring logs are presented in Appendix B.

2.1.2 Site Hydrogeology

Since five existing shallow wells were located at the site, it was not necessary to install temporary piezometers. The well identification numbers for the existing wells used by TtNUS are shown in the table below with their existing well identification number.

TtNUS Well I.D.	Existing Well I.D.
CNC27X-03	NBCE-065-003
CNC27X-04	NBCE-065-004
CNC27X-04D	NBCE-065-004D
CNC27X-05	NBCE-065-005
CNC27X-07	NBCE-065-007

One shallow monitoring well, CNC27-M01, was installed as part of this RA investigation, as shown in Figure 4. The shallow monitoring well was completed to a depth of 12 feet bls. The shallow monitoring well was completed using 10 feet of 0.01-inch machine-slotted, Schedule 40 polyvinyl chloride (PVC) screen that bracketed the water table. A well construction log for this monitoring well is presented in Appendix B. At the completion of the well installation activities, each monitoring well location (new and existing) and the top of casing elevation was surveyed by a South Carolina Registered Professional Surveyor.

Groundwater in shallow wells at Site 27 was encountered at depths ranging from approximately 1.9 to 5.5 feet bls during the RA investigation. The recorded water-level data collected during the RA are presented in Table 1 and the water-level field data sheet is presented in Appendix C. Groundwater elevation measurements were recorded from the site monitoring wells prior to groundwater sampling on September 23, 1999. Figure 8 presents the groundwater potentiometric surface measurements recorded on September 23, 1999. As shown in Figure 8, the potentiometric surface map depicts a groundwater flow divide with existing well CNC27X-03 (NBCE-065-003) at the high point. Southeast of well CNC27X-03, groundwater flows to the southeast past former UST-221, towards the Cooper River. Approximately 10 to 15 feet northwest of well CNC27X-03, groundwater flows to the northwest, away from former UST-221 and the Cooper River. The northwest groundwater flow direction may be the result of influence by a storm drain utility line located between buildings 221 and 56. However, the influence on the water table from the storm drain utility line was not investigated further during this assessment.

As part of the Final RFI Report for Zone E (E/A&H, 1996), a tidal influence investigation was conducted. The objective of the investigation was to provide long-term water level monitoring to determine the effects of the tidal fluctuation on wells and groundwater flow throughout Zone E. During the 4-day tidal study, water levels were recorded in 19 wells throughout Zone E. Measurements were recorded every hour using data loggers. The 4-day period spanned nine high and nine low tide cycles.

Results of the tidal survey identified a maximum fluctuation in shallow monitoring wells of approximately 1 to 2 feet. Monitoring wells located closer to the tidal source were influenced more by tidal changes than wells located on the peninsula. The heterogeneity of the aquifer material may limit or accentuate the tidal response in some wells. Tidal influence from Shipyard Creek appears to be greater than that of the Cooper River (possibly because of the quay wall along the Cooper River). The report concluded that the minimal fluctuations in the groundwater levels were not expected to play a significant role in contaminant transport in any direction other than that determined by the natural groundwater gradient (E/A&H, 1996).

2.2 ASSESSMENT RESULTS

Seven soil borings were completed as part of the screening portion of the soil investigation at Site 27. One soil boring was completed to collect a soil sample for analysis at a fixed-base laboratory to confirm the Chemicals of Concern (CoC). The soil borings for screening evaluation were completed using a DPT rig. Samples were collected to evaluate subsurface soil vapors, soil contaminant concentration (via a mobile laboratory), and groundwater contaminant concentrations (via a mobile laboratory). The soil sample analyzed in the mobile laboratory was collected from a depth of approximately 1-2 feet bls. The soil and groundwater samples collected for mobile laboratory screening were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, and diesel range organics (DRO).

On October 12, 1999, one soil sample for CoC evaluation was collected and analyzed at a fixed base laboratory. This soil sample was analyzed for BTEX, methyl tertiary butyl ether (MTBE), ethylene dibromide (EDB or 1,2-dibromoethane) and naphthalene using U.S. Environmental Protection Agency (USEPA) Method 8260 and polynuclear aromatic hydrocarbons (PAHs) using USEPA Method 8270. In addition, this soil sample was analyzed for metals using standard USEPA methods, total organic carbon (TOC) using USEPA Method 9060, total recoverable petroleum hydrocarbons (TRPH) using USEPA Method 9071A, and grain size analysis using sieve and hydrometer analysis. The sample collection was conducted in accordance with the SCDHEC guidance document "Standard Limited Assessment" (June 1997). Lithologic logs for each soil boring are presented in Appendix B. The soil boring locations are shown on Figure 3, and the soil vapor assessment results are presented in Section 2.3.1.

On September 23, 1999, groundwater samples were collected from five existing wells and one new well. Groundwater sampling was conducted using a peristaltic pump and low flow, quiescent techniques. The monitoring wells were sampled in accordance with SCDHEC's guidance document "South Carolina Risk-Based Corrective Action for Petroleum Releases" (January 1998). Each well was purged of three to six well volumes or until water quality parameters of pH, temperature, and specific conductivity stabilized. The field data sheets are included in Appendix C, and a summary of the field parameter measurements is presented in Table 2.

Groundwater samples were analyzed for BTEX, MTBE, EDB, and naphthalene using USEPA Method 8260 and PAHs using USEPA Method 8270. Groundwater samples were also analyzed for metals using standard USEPA methods. In addition, groundwater samples from three of the wells (CNC27M-01, CNC27X-05, and CNC27X-07) were analyzed for the following natural attenuation parameters: dissolved oxygen, alkalinity, carbon dioxide, manganese, ferrous iron, nitrite, sulfide, nitrogen/nitrate, sulfate and methane. Nitrogen/nitrate, sulfate and methane were analyzed in a fixed base laboratory, and the

remaining natural attenuation parameters were analyzed in the field at the time of sample collection. Groundwater natural attenuation field data are summarized in Table 3, and the field data sheets are included in Appendix C.

2.3 FIELD SCREENING ASSESSMENT

2.3.1 Soil Vapor Assessment

Seven soil borings were completed to evaluate soil vapors as part of the soil screening assessment at Site 27. Total organic vapor headspace concentrations were measured from soil samples using a flame ionization detector (FID). The measurements were recorded periodically from land surface to the termination depth of each boring. Each boring was terminated once the water table or saturated soil conditions were encountered. Due to some equipment malfunctions during this assessment, organic vapors were not measured in three of the borings. Table 4 summarizes the soil vapor screening results, and Figure 3 shows the soil boring locations.

Soil vapor concentrations ranged from non-detect to greater than (>) 5,000 parts per million (ppm). The highest vapor concentrations (> 5,000 ppm) were detected in soil borings CNC27-B01 and CNC27-B02, both at the 4 to 7-foot depth interval. The highest concentration of vapors detected in soil from the remaining sample locations did not exceed 500 ppm. Due to equipment malfunctions, organic vapor concentrations were not measured in soil borings CNC27-B04, CNC27-B06, and CNC27-B07. The soil vapor assessment was used as a screening method to assist in identifying locations for the collection of soil samples and groundwater monitoring wells.

2.3.2 Soil Mobile Laboratory Results

One soil sample collected from boring CNC27-B01 and was analyzed in a mobile laboratory for BTEX, naphthalene and DRO using USEPA Method 8020/8015M. This soil sample was selected based on the soil vapor screening results with the additional criteria that the sample originate in the vadose zone, above the water table. Only one soil sample was collected for analysis in the mobile laboratory because of the following: 1) boring CNC27-B01 was one of two borings containing the highest concentration of organic vapors, 2) boring CNC27-B01 was located adjacent to the former location of UST-221, and 3) the soils in all of the soil boring locations were saturated to a depth of approximately 1-2 feet bls.

None of the constituents analyzed were detected in the soil sample collected from boring CNC27-B01. Table 5 presents a summary of the soil analytical data from the mobile laboratory.

The mobile laboratory soil analysis was used as a screening method to assist in identifying locations for collection of soil samples for fixed base laboratory analysis and locations for groundwater monitoring wells. Soil sample and monitoring well locations were determined in part based on these data.

2.3.3 Groundwater Mobile Laboratory Results

A groundwater sample was collected from each of the 7 soil boring locations and was analyzed by a mobile laboratory for BTEX, naphthalene, and DRO using USEPA Method 8020/8015M. Table 6 summarizes the groundwater analytical data from the mobile laboratory.

As shown in Table 6, no BTEX or DRO constituents were detected in any of the mobile laboratory groundwater samples. Naphthalene was detected in only two groundwater samples at concentrations ranging from 117 µg/L to 28 µg/L with the highest concentration detected in boring CNC27-B01 which was screened from 4 to 7 ft. bls. Naphthalene was not detected in any of the remaining groundwater samples.

The mobile laboratory groundwater analysis was used as a screening method to assist in identifying locations for permanent groundwater monitoring wells.

2.4 CHEMICALS OF CONCERN IN SOIL AND GROUNDWATER

2.4.1 Chemicals of Concern in Soil

One subsurface soil sample was collected from boring CNC27-B07 for determination of CoCs. As requested by SCDHEC, the naphthalene concentrations detected in the soil sample shown in Table 7 are actually total naphthalene concentrations. The total naphthalene concentration value was derived by adding the naphthalene concentration detected using EPA Method 8260 with the 2-methylnaphthalene concentration detected using EPA Method 8270, regardless of the practical quantification limit for each method. The RBSL for sandy soil was used based on a grain size analysis completed on sample 27SLB0701 (boring CNC27-B07 at the 1-2 ft. depth interval) indicating a sandy soil matrix.

No BTEX constituents, naphthalene or PAHs were detected at the method practical quantification limit in the fixed-base laboratory sample. The soil boring location is shown on Figure 3, and Table 7 summarizes the CoCs detected in the soil sample. Soil analytical reports and grain size analysis reports are provided in Appendix D. Since none of the constituents analyzed were detected in the soil sample, it was not necessary to include a figure showing constituents detected in soil.

2.4.2 Chemicals of Concern in Groundwater

Seven groundwater samples (including one duplicate sample) were collected from the Site 27 area for determination of CoCs. The groundwater samples were collected from the five existing wells (four shallow wells and one deep well) and the newly installed shallow well. The monitoring well locations are shown on Figure 3, and Table 8 summarizes the CoCs detected in the groundwater samples. As previously described, the naphthalene concentrations detected in the groundwater samples shown are total naphthalene concentrations. The total naphthalene concentration value was derived by adding the naphthalene concentration detected using EPA Method 8260 with the 2-methylnaphthalene concentration detected using EPA Method 8270.

As shown in Table 8, no BTEX constituents, MTBE, or PAHs were detected at the method practical quantification limit in any of the fixed-base laboratory samples. Naphthalene was detected at a concentration of 7 µg/l and 17 µg/l in the groundwater samples collected from wells CNC27X-04 and CNC27X-03, respectively. The naphthalene concentration of 17 µg/l in well CNC27X-03 slightly exceeds naphthalene's RBSL in groundwater of 10 µg/l.

In addition to the organic analyses, inorganic (metals) parameters were detected in groundwater samples collected from the wells at Site 27. Lead (Pb) was detected at concentrations of 17.5 µg/l, 42.5 µg/l, and 675 µg/l in the groundwater samples collected from wells CNC27M-01, CNC27M-01D (a duplicate sample from well CNC27M-01), and CNC27X-03. All of the concentrations detected in these wells exceed lead's RBSL in groundwater of 15 µg/l. Total chromium was detected at a concentration of 133 µg/l in the groundwater sample collected from well CNC27M-03, exceeding total chromium's RBSL in groundwater of 100 µg/l. No other inorganic parameters analyzed were detected at the method practical quantification limit in these samples or in the groundwater samples collected from the remaining wells.

Groundwater analytical reports are provided in Appendix D. Figures 7, 8, and 9 illustrate the groundwater areal distribution of naphthalene, lead, and total chromium, respectively, for the September 23, 1999, sampling event.

2.5 ANALYTICAL DATA

All analytical data from the June 1996 Underground Storage Tank Assessment Report are presented in Appendix A. Soil analytical data generated during this RA are summarized in Tables 4 and 7. Groundwater analytical data generated during this RA are summarized in Tables 5 and 8. The soil and groundwater analytical reports from the fixed-base laboratory are included in Appendix D.

2.6 AQUIFER CHARACTERISTICS AND EVALUATION

Groundwater levels were measured from the site monitoring wells on September 23, 1999. As shown in Figure 8, the potentiometric surface map depicts a groundwater flow divide trending north-northeast to south-southwest, where existing well CNC27X-03 (NBCE-065-003) is at the high point. Southeast of well CNC27X-03, groundwater flows to the southeast beneath former UST-221, towards the Cooper River. Approximately 10 to 15 feet northwest of well CNC27X-03, groundwater flows to the northwest, away from former UST-221 and the Cooper River. The northwest groundwater flow direction may be the result of influence by a storm drain utility line located between buildings 221 and 56. However, the influence on the water table from the storm drain utility line was not investigated further during this assessment.

The hydraulic gradients for this site was calculated between monitoring wells CNC27M-03 / CNC27M-07 (representing the southeast flow) and CNC27M-03 / CNC27M-05 (representing the northwest flow) using the water table elevation data measured on September 23, 1999. Based on the September 23, 1999, data, the calculated hydraulic gradient to the southeast is 0.0135 feet per foot (ft/ft) and the hydraulic gradient to the northwest is 0.0113 ft/ft, with the average hydraulic gradient at the site being 0.0124 ft/ft.

As part of the Final RCRA Facility Investigation (RFI) Report for Zone E, rising and falling head slug tests were conducted on 20 shallow monitoring wells throughout Zone E to determine the hydraulic conductivity of the surficial aquifer (E/A&H, 1996). The Final RCRA Facility Investigation Report for
Zone E is referenced since Site 27 is located within Zone E. Slug tests were conducted by instantaneously adding (falling head) or removing (rising head) a volume (slug) of water from the well and measuring the recovering water level with a data logger. A hydraulic conductivity value was then calculated for the rising head test and for the falling head test. The average hydraulic conductivity for each well was determined by calculating the geometric mean of the rising and falling head values. Because hydraulic conductivity data are lognormally distributed, the geometric mean was determined to be the most representative measure of central tendency.

The well construction details and boring logs for each well tested during the RFI were reviewed to determine which wells were most representative of the conditions present at Site 27. To make this determination the screened interval, lithology, and proximity to the site were evaluated. Based on this evaluation, monitoring well NBCE-065-001 was selected as the most representative well. NBCE-065-001 is located approximately 190 feet north (sidegradient) of the former location of UST-221 and is completed to a depth of approximately 12.5 feet with a 9-foot screened interval. This well was selected because it was one of the existing wells located in the vicinity of the former UST system. The geometric mean of the

rising and falling head conductivities for NBCE-065-001 was 3.8 feet per second (ft/sec) or 32.6 feet per day (ft/day).

Potential movement of groundwater at the site may be described in terms of transportation by natural flow system in the saturated zone, assuming groundwater flow follows Darcy's Law. Darcy's Law may be expressed as:

$$V = \left(\frac{K}{n}\right) x\, i$$

where:

V = average velocity

K = hydraulic conductivity = 32.6 ft/day

n = effective porosity = 0.55
[from sieve results of 40.7% sand & 0.8 clay and Figure C1 in SCDHEC, 1998]

i = average hydraulic gradient measurement = 0.0124 ft/ft

therefore:

$$V = \left(\frac{32.6\ \text{ft/day}}{0.55}\right) x\ 0.0124\ \text{ft/ft}$$

$$V = 0.735\ \text{ft/day}$$

In summary, the seepage velocity of the surficial aquifer was calculated to be approximately 268 feet per year based on a hydraulic conductivity of 0.32.6 ft/day, a hydraulic gradient of 0.0124 ft/ft, and a porosity of 55 percent for sandy soil. Aquifer characterization graphs are provided in Appendix E.

2.7 FATE AND TRANSPORT

The Domenico Dilution/Attenuation Model was the fate and transport model used to determine groundwater site-specific target levels (SSTLs) in the risk analysis. The Domenico Model is presented in the SCDHEC guidance document, *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC 1998). This model is very conservative in that it assumes an infinite mass, areal source condition through which groundwater flows. The model incorporates biological decay effects through a first-order decay process, however, this mechanism was ignored because SCDHEC guidance specifies that the decay rate must be assumed to be zero if site-specific decay rates have not been determined.

The impacted groundwater source area was modeled as 50 feet (15.00 meters) wide and 6.56 feet (2.0 meters) deep; these values are conservative defaults suggested by the American Society for Testing Materials (ASTM) *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM, 1997). The maximum source concentrations are assumed to exist throughout the source area, further compounding the conservatism of the estimate.

Site-specific data were used for saturated hydraulic conductivity, hydraulic gradient, porosity, and fraction of organic carbon in soil (1.17E-04 m/sec, 0.0124 ft/ft, 0.47 cm^3/cm^3, and 1.75E-3 g-C/g-soil, respectively). The SCDHEC default value for soil bulk density (1.45 g/cm^3) in sandy soil was used.

The following estimates of dispersivity were used in the Domenico Model as given in SCDHEC (1998):

Parameter	Estimate
Longitudinal Dispersivity, α_x	x/10, where x= distance between the point of exposure and the source or compliance point
Transverse Dispersivity, α_y	$\alpha_x/3$
Vertical Dispersivity, α_z	$\alpha_x/20$

Table 9 summarizes fate and transport parameters used in modeling the SSTLs.

2.8 PREDICTED MIGRATION AND ATTENUATION OF CHEMICALS OF CONCERN

Groundwater flow at the site is divided. Southeast of well CNC27X-03, groundwater flows to the southeast beneath former UST-221, towards the Cooper River. Approximately 10 to 15 feet northwest of former UST-221, groundwater flows to the northwest, away from former UST location and the Cooper River. The northwest groundwater flow direction may be the result of influence by a storm drain utility line located between buildings 221 and 56. The current extent of groundwater impact, where RBSLs are exceeded, is

limited to concentrations of naphthalene, lead, and total chromium in well CNC27X-03, and concentrations of lead in well CNC27M-01

The Domenico Model was used to predict the distance at which the tip of the plume is attenuated to SCDHEC RBSLs in 10 and 20 years without using degradation due to biological decay. This was done by adjusting the time to 10 years ($3.15x10^8$ sec) and 20 years ($6.31x10^8$ sec) and solving for distance (x) by trial and error. The source was assumed to be well CNC27X-03. The distance was changed until the required distance that is necessary for the concentration to attenuate to the RBSLs was determined. The table below shows the model estimates after 10 and 20 years for migration of naphthalene, lead, and total chromium using their respective RBSLs as the indicator of the downgradient plume edge.

Domenico Model Time Period	CoC	Estimated Distance Traveled (feet)	Time Period Equilibrium Reached (years)
10 year	Naphthalene	65	3.9
	Lead	420	3.5
	Total Chromium	51	0.5
20 year	Naphthalene	65	3.4
	Lead	420	3.5
	Total Chromium	51	0.5

All examined constituents reach equilibrium prior to the ten-year period used in the initial calculations. The maximum distance traveled by total chromium is approximately 50 feet after approximately 0.5 years. Naphthalene and lead both reach equilibrium after 3-4 years of migration. According to the calculations, naphthalene, lead, and chromium will migrate from Site 27 to the Cooper River within 10 years. The Cooper River is approximately 75-100 feet southeast of Site 27. The Domenico Model calculations are presented in Appendix F.

3.0 TIER 1 and 2 EVALUATION

3.1 COMPARISON OF ANALYTICAL RESULTS WITH RBSLs

Soil CoC concentrations were below the RBSLs for leaching in sandy soils and dermal contact and ingestion of surficial soil. Therefore, no further evaluation of the risks of soil contamination is necessary.

However, CoC concentrations in two groundwater samples exceeded the RBSLs and are shown in the following table. The groundwater RBSLs are presented in the SCDHEC guidance document, *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC 1998).

Monitoring Well / Sample No.	Naphthalene (ug/L)	Lead (ug/L)	Total Chromium (ug/L)
RBSL	10	15	100
CNC27M-01 / 27GLM0101	Below RBSL	**42.5**	Below RBSL
CNC27M-01 / 27GLM0101D (duplicate sample)	Below RBSL	**17.5**	Below RBSL
CNC27X-03 / 27GLX0301	**17**	**675**	**133**

A Site Conceptual Exposure Model (identification of current and future potential receptors and human exposure pathways) is required because RBSLs for naphthalene, lead, and total chromium in groundwater were exceeded. The Site Conceptual Exposure Model is described in the following section (Section 3.2).

3.2 SITE CONCEPTUAL EXPOSURE MODEL

This section focuses on the current and future land use issues concerning the site. Figure 1 shows that the site is located in and surrounded by the CNC. The area surrounding CNC is "mature urban," having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. The future use of the property is expected to be industrial or commercial for the foreseeable future after the property is made available for redevelopment under the Base Realignment and Closure Act (BRAC).

Drinking water at the site and surrounding properties is provided by the City of Charleston (City) water treatment plants. A survey of groundwater users within a 7-mile radius of the CNC was provided by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. The survey identified no drinking water wells that are screened in the shallow aquifer within a 4-mile radius of the CNC.

3.3 EXPOSURE PATHWAY ANALYSIS

This section presents the receptor characterizations of the potentially exposed populations in the vicinity of the site and identifies the potentially complete exposure pathways for those receptors. SCDHEC requires that only those exposure pathways with CoC concentrations exceeding Tier 1 RBSL concentrations be examined in a Tier 2 Risk-Based Corrective Action (RBCA) report. Tables 10 and 11 present the exposure pathway assessments for current and future use scenarios, respectively.

3.3.1 On-Site Commercial/ Industrial Worker

An on-site commercial or industrial worker is defined as a business employee who works in a commercial/ industrial capacity at the site. The future use of the property is expected to be industrial or commercial for the foreseeable future, therefore, an on-site worker was considered as a potential receptor. Drinking water at this site is provided by the city, therefore, ingestion of groundwater is not a complete exposure pathway. Building foundations are assumed sufficient to prevent volatilization from both soil and groundwater into a commercial building, and there is no history of vapors in the commercial building. It is unlikely that any additional exposure pathways will exist for future on-site workers, therefore, no complete pathways exist for either current or future commercial/industrial workers.

3.3.2 On-Site Visitor

An on-site visitor is defined as any person other than a worker who might come on site. On-site visitors would have the same exposure pathways as commercial workers, but their exposure duration would be much shorter. This receptor does not have to be quantified because a potential on-site visitor's chemical intake would not drive risk or cleanup levels at the site.

3.3.3 On-Site Construction Worker

An on-site construction worker is defined as a laborer who would be involved in intrusive activities on or around the site, particularly in the area of subsurface utilities. On-site construction workers could be exposed to constituents in groundwater by the following pathways: inhalation of volatiles from

groundwater, dermal contact with groundwater, and incidental ingestion of groundwater. Utility lines are adjacent the site; therefore, the point of exposure location for the on-site construction worker was considered to be at the source.

3.3.4 On-Site Resident

An on-site resident is defined as any person making his or her home at the site. This site is expected to remain a commercial/industrial facility, therefore, the on-site resident receptor was not considered further.

3.3.5 Off-Site Resident

An off-site resident is defined as any person making his or her home near the site. This receptor's location is either an actual current residence near the site or is a vacant lot or property on which a residence could be built. The site is located in an area that will likely remain commercial/industrial, including all downgradient properties to the Cooper River. Therefore, this potential receptor was not considered further.

3.3.6 Surface Water

The Cooper River is located approximately 75 to 100 feet southeast (downgradient) of the site. Since the base-wide groundwater flow direction primarily to the east, towards the river, this exposure pathway was considered for ingestion of surface water.

3.4 IDENTIFICATION OF DATA REQUIREMENTS

No additional data are required to calculate SSTLs for the site.

3.5 SITE-SPECIFIC TARGET LEVELS

The Site Conceptual Model identified two possible future receptors: a construction worker in a utility trench and the Cooper River. The pathways for the construction worker include possibly ingesting, having dermal contact with, or inhaling volatilized vapors from the groundwater in the utility trench. The pathway for the Cooper River is groundwater migration to the river from the site.

3.5.1 Groundwater SSTLs Protective of the On-Site Construction Worker

Groundwater RBSLs provided by SCDHEC are for ingestion only. Therefore, groundwater RBSLs for a construction worker in a utility trench were calculated for three pathways: dermal contact, incidental ingestion, and inhalation of volatiles. A target cancer risk of 1×10^{-6} and a target hazard quotient of 1 were used in the calculations. Where possible, site-specific parameters were used for site conditions. Standard defaults were used when available and applicable to a construction worker. When no standard parameters were available, conservative assumptions were used. For all pathways, the exposure frequency was assumed to be 90 days/year and the exposure duration was assumed to be 1 year. These assumptions were considered conservative based on the nature of utility work.

The dermal contact RBSLs were calculated using procedures *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment, Interim Guidance* (USEPA Peer Consultation Workshop Draft, 1998). Based on expected limited contact with groundwater, the event frequency was assumed to be 1 event/day and the event duration was assumed to be 1 hour/event. The skin surface area available for contact was 4,500 cm^2, based on one-fourth the skin surface area given in the risk assessment guidance document for a swimming adult.

The incidental ingestion RBSLs were calculated using the equation given in *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Interim Final)*, (USEPA 1989). An incidental ingestion rate of 0.01 L/day was assumed based on a fraction (12.5%) of the incidental ingestion rate for a wading adult (0.01 L/hr), considered for an 8-hour work day. The incidental ingestion rate for wading adults is given in *Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment* (USEPA Region 4, 1995).

Utility lines in the area are typically buried 2 to 6 feet deep. The depth to groundwater at the point of exposure [Monitoring Well CNC27X-03 (NBCE-065-003)] is 2.24 feet bls, with a range of 2 to 6 feet bls for the site. It was assumed that a construction worker might be exposed to chemicals volatilizing from standing groundwater. The inhalation RBSLs were calculated using Henry's Law:

$$RBSL_{WATER} = RBSL_{AIR}/H$$

Where H = Henry's Law constant [mg/L-air/mg/L-water]

The $RBSL_{AIR}$ for each chemical was calculated using the equation given in the American Society of Testing and Materials (ASTM) *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (1997). SCDHEC values were used for Henry's Law constants.

Underground utilities are present in close proximity to the site, therefore, the point of exposure location for the on-site construction worker was considered to be at the source. As a result, no fate and transport calculations were performed to determine the SSTL protective of the construction worker. The minimum RBSL for the three pathways was chosen as the SSTL for the construction worker.

It should be noted that construction worker RBSLs for lead were not calculated. Lead is considered nonvolatile, therefore, not an inhalation hazard. In addition, since lead is non-absorbable, it is not a dermal hazard. However, lead is an ingestion hazard, but pertinent data are unavailable to calculate a receptor-specific RBSL. Instead, a surface water/human/non-drinking water value (HNDV) was used to compare to the source concentrations and as an SSTL. The HNDV value was taken from the State of Michigan's Generic Cleanup Criteria and Screening Levels for Groundwater-Surface Water Interface Criteria (State of Michigan, May 28, 1999).

The following table shows the calculated RBSLs for each pathway and the SSTL for the construction worker. Appendix F provides the parameters and results of the RBSL calculations.

Chemical of Concern	Dermal RBSL, mg/L	Incidental Ingestion RBSL, mg/L	Inhalation RBSL, mg/L	SSTL (Minimum RBSL, mg/L)	Maximum Source Concentration Source, mg/L	Exceeds SSTL
Naphthalene	1.63	1135.56	2.63	1.63	0.017	No
Lead *	NA	NA	NA	0.19 *	0.675	**Yes**
Total Chromium	2.37	85.17	NA	2.37	0.133	No

Notes:
* A construction worker-specific RBSL could not be calculated for lead because of unavailable data and the characteristics of lead being non-volatilizing and non-absorbing. The above SSTL for lead was obtained from the State of Michigan's Generic Cleanup Criteria and Screening Levels .

As shown in the above table, the minimum RBSL for naphthalene and chromium are greater than the greatest onsite concentration of each CoC detected in site groundwater. Therefore, a construction worker in a utility trench exposed to groundwater containing naphthalene and/or chromium from Site 27 is not at risk from exposure. However, the construction worker is at risk if exposed to lead in the groundwater.

3.5.2 Groundwater SSTLs Protective of Surface Water

SSTLs were developed which would protect the Cooper River from potential impact from discharge of impacted groundwater. The Domenico Model, as described in Section 2.7, was used to determine the groundwater SSTLs for naphthalene, lead, and total chromium under steady state conditions. Table 9 provides fate and transport parameters used in the model. Groundwater flow at the site (downgradient of

former UST-221) is to the southeast, towards the Cooper River, which is located approximately 75 to 100 feet from the site. Monitoring well CNC27X-03 (NBCE-065-003) contained naphthalene, lead, and/or total chromium concentrations greater than the Groundwater Ingestion RBSLs, therefore, the area surrounding this monitoring well was used as the source for predicted migration.

The dissolved naphthalene, lead, and total chromium concentrations in well CNC27X-03 were used in the Domenico Model as the source concentrations. The distance from well CNC27X-03 to the Cooper River, which is the nearest point of exposure other than construction worker, was estimated to be between 75 to 100 feet. Using the RBSL values of 0.01, 0.015, and 0.100 mg/L for naphthalene, lead, and total chromium, respectively, at the point of exposure, the SSTL at well CNC27X-03 was calculated and compared with the source concentration in well CNC27X-03. The SSTL at an estimated compliance well was also calculated using the values of the RBSLs at the point of exposure. However, there is no actual compliance well at the site. A compliance well should be installed as part of Corrective Action activities. The distance from the compliance well to the point of exposure was estimated to be 100 feet.

Groundwater SSTLs were determined and are listed in the following table.

Chemical of Concern	Maximum Source Concentration [mg/L]	Source SSTL [mg/L]	Compliance Point SSTL [mg/L]	Exceeds SSTL
Naphthalene	0.017	0.910	0.031	No
Lead	0.675	1.365	0.047	No
Total Chromium	0.133	9.099	0.311	No

As shown in the above table, the current concentrations at monitoring well CNC27X-03 are below the calculated SSTLs for affecting the Cooper River, therefore, the Cooper River is not at risk because of the naphthalene, lead, and total chromium concentrations in groundwater at the site. Appendix F provides the Domenico Model calculations generating SSTLs.

3.5.3 Selected SSTLs

The selected SSTLs and the source concentrations are listed in the following table.

Media of Concern	Chemical of Concern	Units	Minimum SSTL	Maximum Source Concentration	Exceeds SSTLs
Groundwater	Naphthalene	mg/L	0.910	0.017	No
	Lead	mg/L	0.190	0.675	**Yes**
	Total Chromium	mg/L	2.37	0.133	No

As shown in the table above, the maximum concentrations for naphthalene and chromium found onsite are less than the respective minimum SSTLs, therefore, naphthalene and chromium in groundwater do not pose a threat to the identified receptors at the site. However, the maximum concentration for lead found on site exceeds it's the minimum SSTL, therefore, lead in groundwater poses a threat to a construction worker in a utility trench exposed to groundwater.

3.6 RECOMMENDATIONS

Because concentrations for lead in groundwater exceed the minimum SSTL protective of a construction worker in a utility trench, Tetra Tech NUS, Inc. recommends preparing an Active Corrective Action Plan.

4.0 REFERENCES

E/A&H (Ensafe/Allen & Hoshall), Inc. 1996. Final RCRA Facility Investigation for Zone H, Naval Base Charleston, Charleston, South Carolina, July 5, 1996.

SCDHEC (South Carolina Department of Health and Environmental Control), 1997. South Carolina Standard Limited Assessment, June 1997.

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SPORTENDETCHASN, 1999. Personal Contact between Paul Calligan TtNUS and Copes Wannamacker SPORTENDCHASN, June 17, 1999.

STATE OF MICHIGAN, DEPARTMENT OF ENVIRONMENTAL QUALITY, May 28, 1999. Revised Part 201 Operational Memorandum #18 Cleanup Criteria Tables, Footnotes (G), Lansing, Michigan, May 28, 1999.

TABLE 1

GROUNDWATER ELEVATIONS
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL BASE COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well #	Total Depth of Well (ft)	Top of Casing Elevation, ft (MSL)	Date Measured	Depth to Water, ft (BTOC)	Depth to Product, ft (BTOC)	Product Thickness (ft)	Groundwater Elevation (MSL)
CNC27M-01	11.68	7.85	9/23/1999	1.99	ND	ND	5.86
CNC27X-03	12.43	8.14	9/23/1999	2.24	ND	ND	5.90
CNC27X-04	12.41	8.09	9/23/1999	2.33	ND	ND	5.76
CNC27X-04D	39.62	8.39	9/23/1999	5.54	ND	ND	2.85
CNC27X-05	12.40	8.22	9/23/1999	3.22	ND	ND	5.00
CNC27X-07	13.16	8.34	9/23/1999	3.32	ND	ND	5.02

Notes:
MSL - Mean Sea Level
BTOC - Below Top of Casing
ND- Not Detected
ft - Feet

TABLE 2

GROUNDWATER FIELD MEASUREMENTS
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Purge method	Volume (gallons)	Temp. (° C)	pH	Specific Conductivity (uMHOS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)
CNC27M-01	9/23/1999	PP	2.50	26.1	7.19	0.304	-10	1.34
CNC27X-03	9/23/1999	PP	6.00	27.3	8.94	0.671	10	0.52
CNC27X-04	9/23/1999	PP	4.83	27.2	7.17	0.553	12	1.99
CNC27X-04D	9/23/1999	PP	4.80	23.2	6.74	1.480	14	1.58
CNC27X-05	9/23/1999	PP	4.41	25.7	6.57	0.610	12	2.46
CNC27X-07	9/23/1999	PP	4.00	28.2	6.93	0.761	11	1.53

Notes:
(° C) - Degrees Celsius
PP - Peristaltic pump, low flow technique
uMHOS/cm - Micro HOS per centimer
NTU - Nephelometric turbidity units
mg/l - milligrams per liter

TABLE 3

GROUNDWATER NATURAL ATTENUATION FIELD MEASUREMENTS
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Dissolved Oxygen (mg/l)	Alkalinity (mg/l)	Carbon Dioxide (mg/l)	Sulfide (mg/l)	Ferrous Iron (mg/l)	Nitrite (mg/l)	Manganese (mg/l)	Nitrogen/ Nitrate* (mg/l)	Sulfate* (mg/l)
CNC27M-01	9/23/1999	0.40	241	212	0.02	0.03	0.081	0.1	<0.050	16
CNC27X-05	9/23/1999	3.00	203	203	0.02	3.30	0.042	0.5	<0.050	92
CNC27X-07	9/23/1999	1.00	343	230	0.02	1.70	0.044	0.0	<0.050	<1.0

Notes:

mg/l - Milligrams per liter

NA - Not Analyzed

* Fixed base laboratory analysis

TABLE 4

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 27, BUILDING 221
ZONE E, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration
CNC27-B01	27SSB0104	0-4	0
	27SSB0107	4-7	(>5000 PPM IN BOREHOLE)
CNC27-B02	27SSB0202	0-2	500
	27SSB0207	4-7	(>5000 PPM IN BOREHOLE)
CNC27-B03	27SSB0302	0-2	0
	27SSB0304	2-4	0
CNC27-B04	27SSB0404	0-7	No Recording
CNC27-B05	27SSB0504	0-4	0
CNC27-B06	27SSB0601	1-4	No Recording
CNC27-B07	27SSB0701	1-5	No Recording

Notes:
OVA - organic vapor analyzer equipped with a flame ionization detector
PPM – Parts Per Million

TABLE 5

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR SOIL
SITE 27, BUILDING 221
ZONE E, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data[1]					
			Benzene (µg/Kg)	Toluene (µg/Kg)	Ethylbenzene (µg/Kg)	Total Xylenes (µg/Kg)	Naphthalene (µg/Kg)	Diesel Range Organics (mg/Kg)
CNC27-B01	27SFB070102	1-2	ND	ND	ND	ND	ND	ND

NOTES:
[1] Laboratory screening data was analyzed using USEPA Method 8020/8015M. Compounds not detected are reported as less than the instrument detection limit.
µg/Kg = micrograms per kilogram
mg/Kg = milligrams per kilogram

TABLE 6

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR GROUNDWATER
SITE 27, BUILDING 221
ZONE E, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data[1]					
			Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Naphthalene (µg/L)	Diesel Range Organics (mg/L)
CNC27-B01	27GFB010407	4-7	ND	ND	ND	ND	28	ND
CNC27-B02	27GFB020407	4-7	ND	ND	ND	ND	ND	ND
CNC27-B03	27GFB030407	4-7	ND	ND	ND	ND	17	ND
CNC27-B04	27GFB040407	4-7	ND	ND	ND	ND	ND	ND
CNC27-B05	27GFB050407	4-7	ND	ND	ND	ND	ND	ND
CNC27-B06	27GFB060204	2-4	ND	ND	ND	ND	ND	ND
CNC27-B07	27GFB070304	3-4	ND	ND	ND	ND	ND	ND

NOTES:
[1] Laboratory screening data was analyzed using USEPA Method 8020/8015M. Compounds not detected are reported as less than the instrument detection limit.
µg/L = micrograms per liter
mg/L = milligrams per liter

TABLE 7

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL [1]		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC27-B07 / 27SLB0701	12-Oct-99	< 5	< 5	< 5	< 5	< 355	< 355	< 355	< 355	< 355	< 5

All concentrations are in micrograms per kilograms (ug/kg).
[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet.

TABLE 8

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 27, BUILDING 221
ZONE E CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	Dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL[1]		5	700	1000	10,000	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	10 [2]	40
CNC27M-01 / 27GLM0101	23-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC27M-01 / 27GLM0101D	23-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC27X-03 / 27GLX0301	23-Sep-99	< 5	< 5	< 5	< 5	**17**	< 11	< 11	< 11	< 11	< 11	< 5
CNC27X-04 / 27GL0401	23-Sep-99	< 5	< 5	< 5	< 5	7	< 11	< 11	< 11	< 11	< 11	< 5
CNC27X-4D / 27GL4D01	23-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC27X-05 / 27GLX0501	23-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5
CNC27X-07 / 27GLX0701	23-Sep-99	< 5	< 5	< 5	< 5	< 5	< 11	< 11	< 11	< 11	< 11	< 5

All concentrations are in ug/L (micrograms per Liter).

[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

[2] The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

TABLE 8 - Continued

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 27, BUILDING 221
ZONE E CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Lead (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Cadmium (ug/L)	Total Chromium (ug/L)	Mercury (ug/L)	Selenium (ug/L)	Silver (ug/L)
RBSL[1]		15	50	2000	5	100	2	50	5
CNC27M-01 / 27GLM0101	23-Sep-99	**42.5**	12.6	55.1	< 2.1	< 11.4	< 0.09	< 2.57	< 2.54
CNC27M-01 / 27GLM0101D	23-Sep-99	**17.5**	8.4	47	< 1.94	< 4.6	< 0.04	< 2.57	< 2.54
CNC27X-03 / 27GLX0301	23-Sep-99	**675**	9.4	19.9	< 0.34	**133**	0.34	< 2.57	< 2.54
CNC27X-04 / 27GL0401	23-Sep-99	< 1.09	< 3.8	19.9	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54
CNC27X-4D / 27GL4D01	23-Sep-99	< 1.09	31.8	65.4	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54
CNC27X-05 / 27GLX0501	23-Sep-99	< 4.9	16.3	17	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54
CNC27X-07 / 27GLX0701	23-Sep-99	< 2.2	< 4.3	80.3	< 1.94	< 4.31	< 0.02	< 2.57	< 2.54

All concentrations are in ug/L (micrograms per Liter).
[1] South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

TABLE 9

FATE AND TRANSPORT INPUT PARAMETERS
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Parameter	Domenico Dilution/Attenuation Model[1]
Hydraulic Conductivity [m/sec]	1.17E-04
Hydraulic Gradient [ft/ft]	0.0124
Porosity [cm3/cm3]	0.47
Estimated Plume Length [ft]	NA
Soil Bulk Density(a) [g/cm3]	1.45
Partition Coefficient [L/kg]	chemical specific
Fraction of Organic Carbon in soil [g/g]	1.75E-03
First Order Decay Rate [sec-1]	0
Modeled Plume Length [ft]	NA
Modeled Plume Width [ft]	NA
Source Width(b) [m]	15
Source Thickness(b) [m]	2
Soluble Mass [kg]	Infinite[c]

Notes:
(1) - *South Carolina Risk-Based Corrective Action for Petroleum Releases,* South Carolina Department of Health and Environmental Control, 1998.
(2) - Default value

TABLE 10

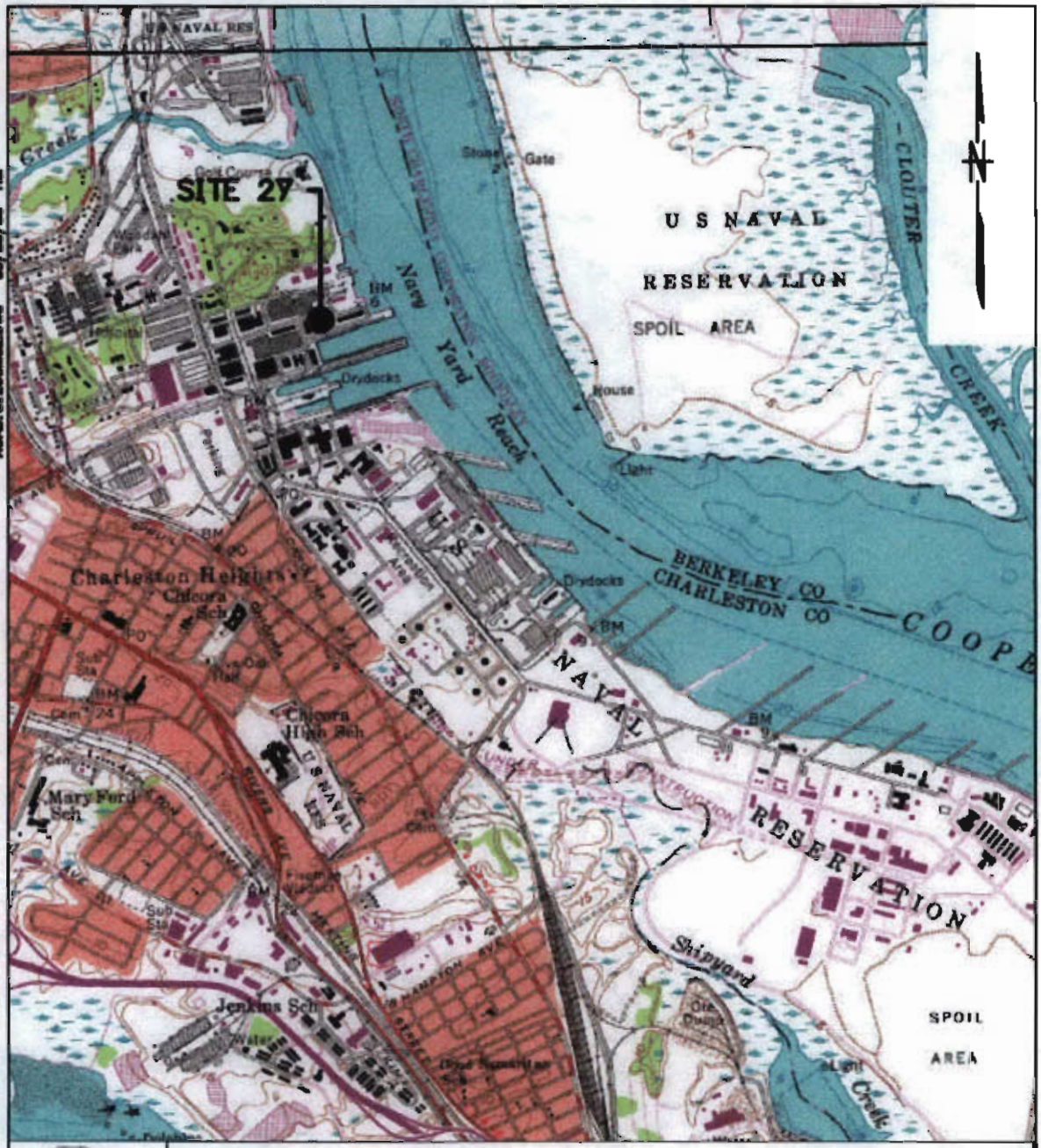
EXPOSURE PATHWAY ASSESSMENT - CURRENT USE
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space.	
	Explosion Hazard	No	No explosion hazard.	
Groundwater	Ingestion	No	No water supply well downgradient or residential basements.	
	Dermal contact	No		
	Inhalation	No		
Surface Water	Ingestion	No	Cooper River approximately 600 feet downgradient. No completed pathway.	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil	
	Dermal contoct	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No current complete pathway.	
	Dermal contact	No		
	Inhalation	No		
	Leaching to Groundwater	No		

TABLE 11

EXPOSURE PATHWAY ASSESSMENT - FUTURE USE
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space.	
	Explosion Hazard	Na	No explosian hazard.	
Groundwater	Ingestion	Yes	Future use of property expected to be industrial or commercial. Underground utility lines within close proximity to the site; therefore, construction worker exposure possible.	No additional data required
	Dermal contact	Yes		
	Inhalation	Yes		
Surface Water	Ingestion	Yes	Cooper River 600 feet downgradient. Ingestion is considered the most conservative pathway therefore the only one analyzed.	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil.	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No impacted subsurface soil.	
	Dermal contact	No		
	Inhalation	No		
	Leaching to Groundwater	No		



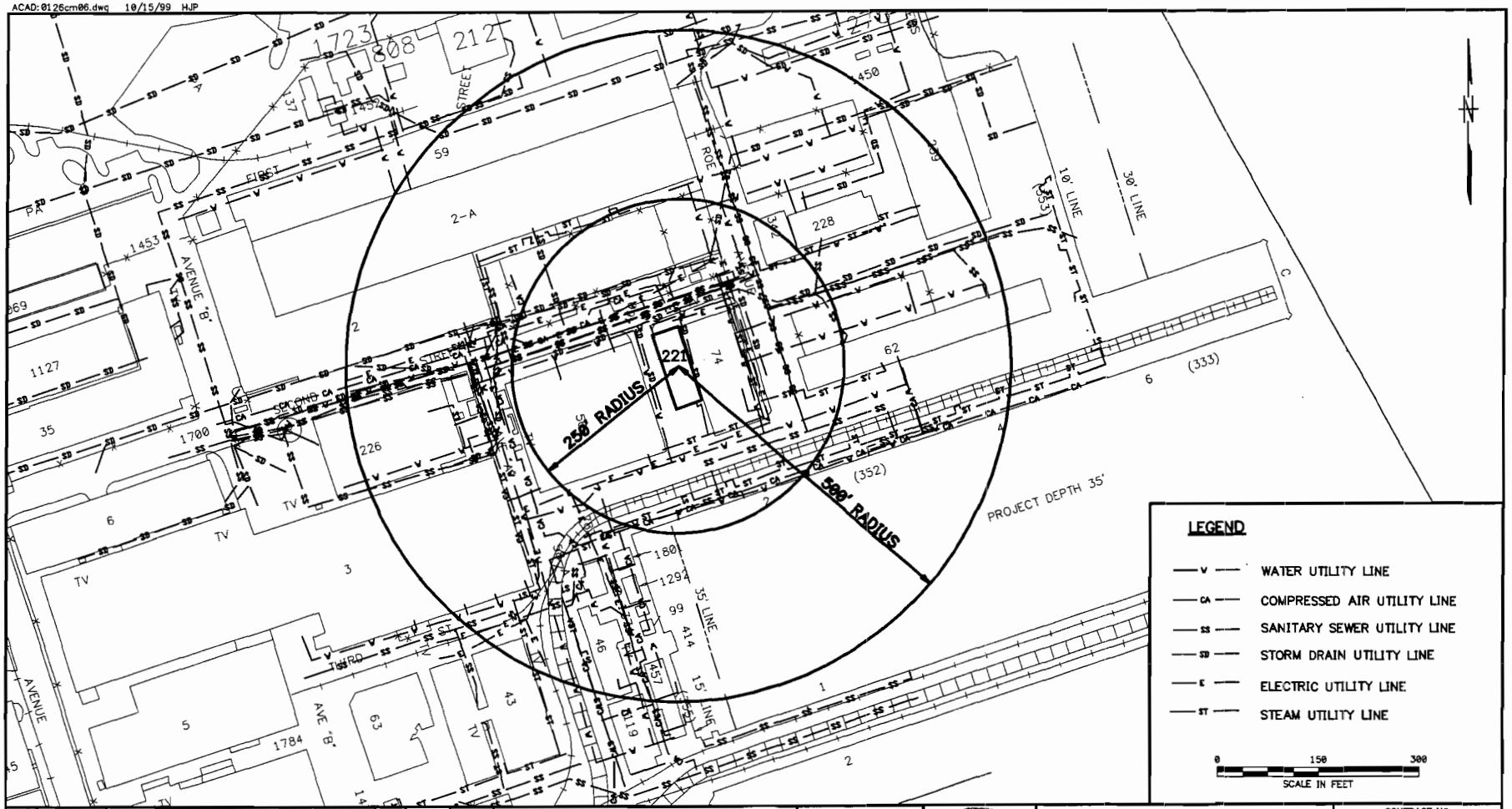
SOURCE: QUADRANGLE MAP SOUTH CAROLINA, REVISED 1978
QUADRANGLE MAP NORTH CHARLESTON REVISED, 1978

0 2000 4000
SCALE IN FEET

DRAWN BY HJP DATE 8/20/99	SITE LOCATION MAP SITE 27, BUILDING 221 ZONE E, CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA	CONTRACT NO. N0126
CHECKED BY DATE		APPROVED BY DATE
COST/SCHED-AREA		APPROVED BY DATE
SCALE AS NOTED		DRAWING NO. FIGURE 1 REV. 0

FORM CADD NO. 5SEV_AV.DWG - REV 0 - 1/28/98

ACAD:0126cm06.dwg 10/15/99 HJP



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

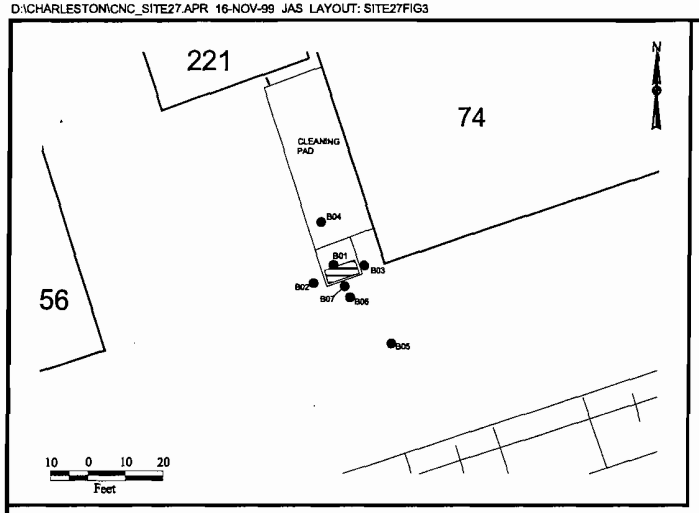
DRAWN BY DATE: HJP 10/15/99
CHECKED BY DATE:
COST/SCHED—AREA:
SCALE: AS NOTED

SITE VICINITY MAP
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

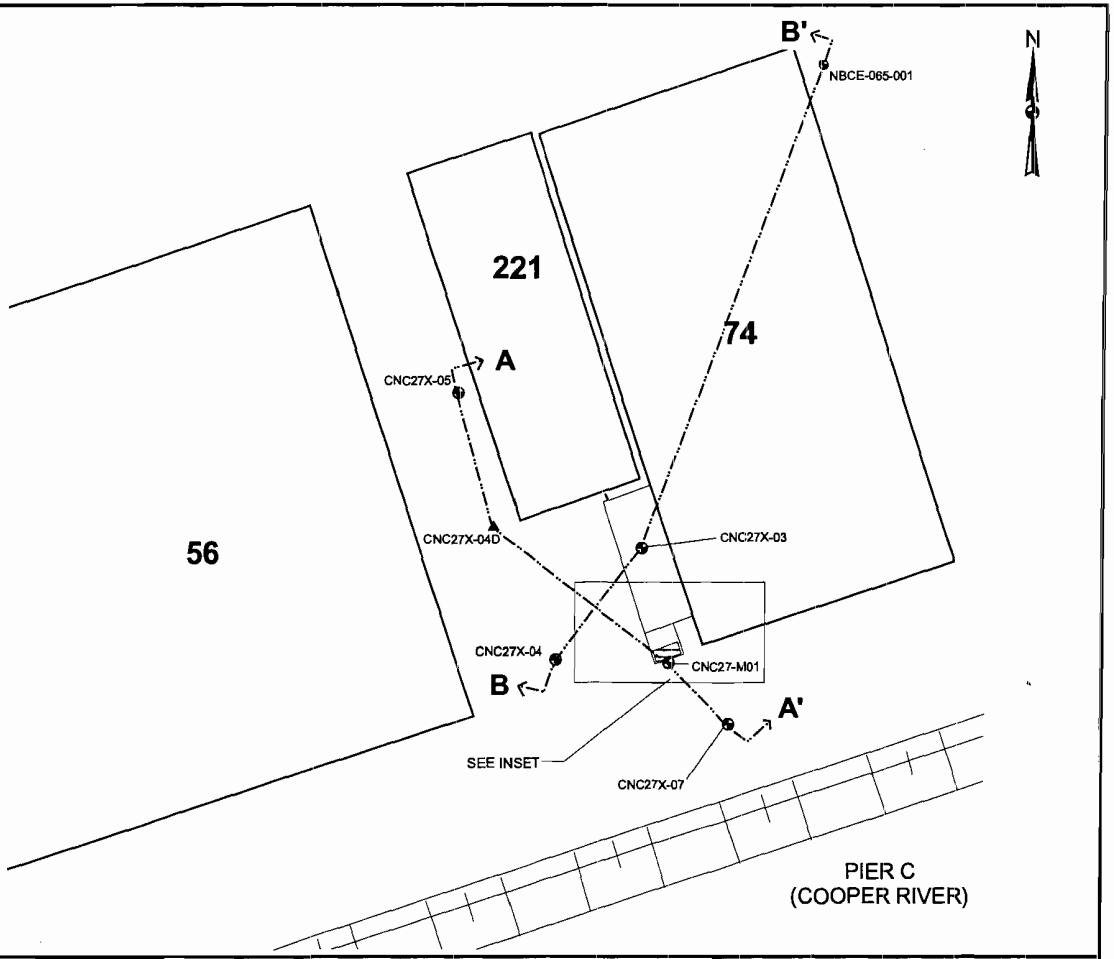
CONTRACT NO. 0126
APPROVED BY: DATE:
APPROVED BY: DATE:
DRAWING NO. FIGURE 2
REV. 0

FORM CADD NEI SIEV_BLDWG - REV 0 - 1/20/98

D:\CHARLESTON\CNC_SITE27.APR 16-NOV-99 JAS LAYOUT: SITE27FIG3



INSET



LEGEND:

- ▲ Deep Monitoring Well
- ⊕ Monitoring Well
- ● Soil Boring Locations
- ▤ UST 221-1 Excavation

CNC27X03 = NBCE-065-003
CNC27X04 = NBCE-065-004
CNC27X4D = NBCE-065-04D
CNC27X05 = NBCE-065-005
CNC27X07 = NBCE-065-007

25 0 25 50 75
Feet

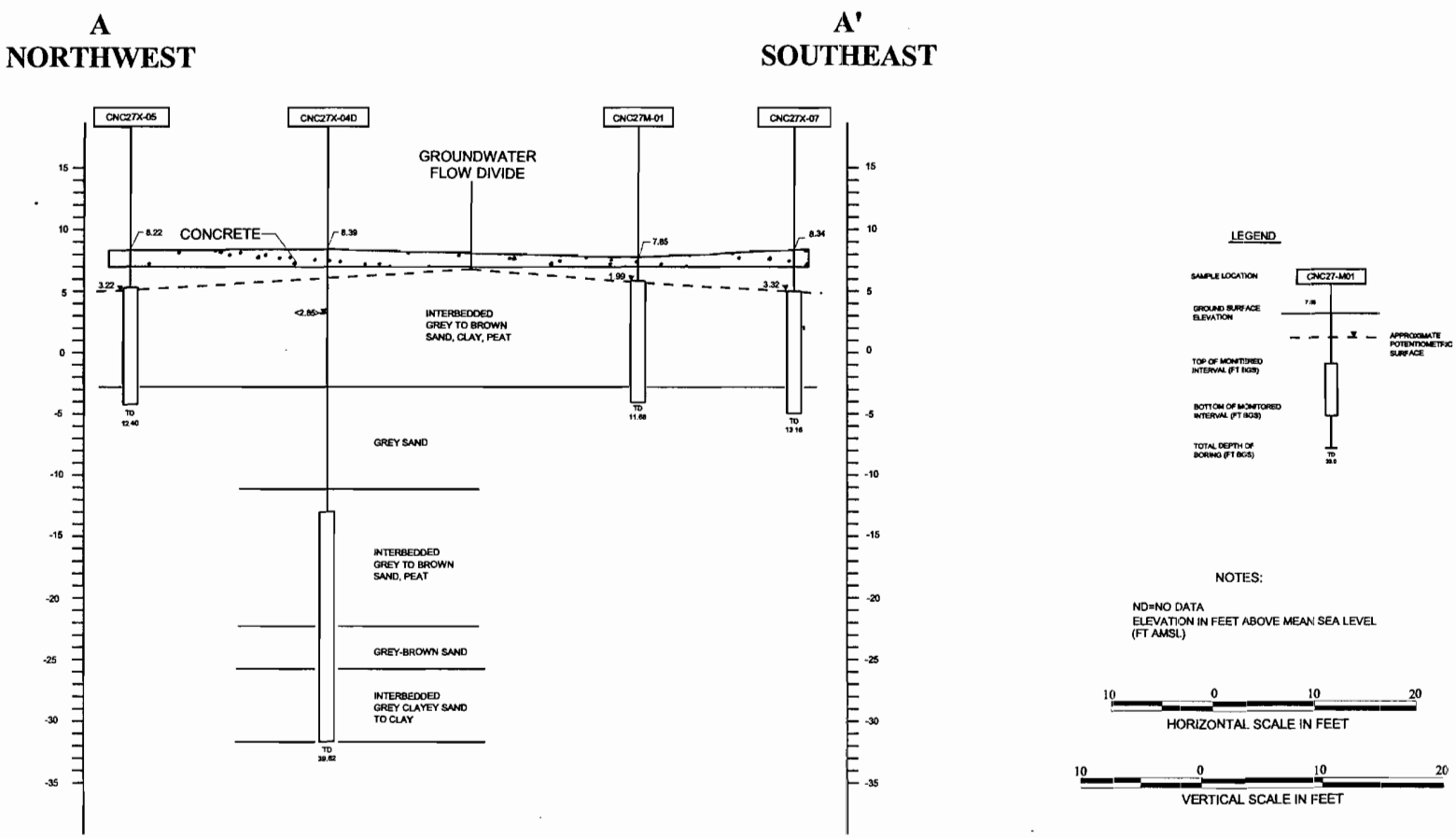
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY JAS — DATE 11-17-99
CHECKED BY — DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE MAP SHOWING
SAMPLE LOCATIONS
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0126
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 3 — REV. 0

D:\CHARLESTON\CNC_SITE27.APR 17-NOV-99 JAS LAYOUT: SITE27FIG4



LEGEND

NOTES:

ND=NO DATA
ELEVATION IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)

HORIZONTAL SCALE IN FEET

VERTICAL SCALE IN FEET

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: JAS	DATE: 11-17-99
CHECKED BY:	DATE:
COST/SCHED-AREA	
SCALE: AS NOTED	

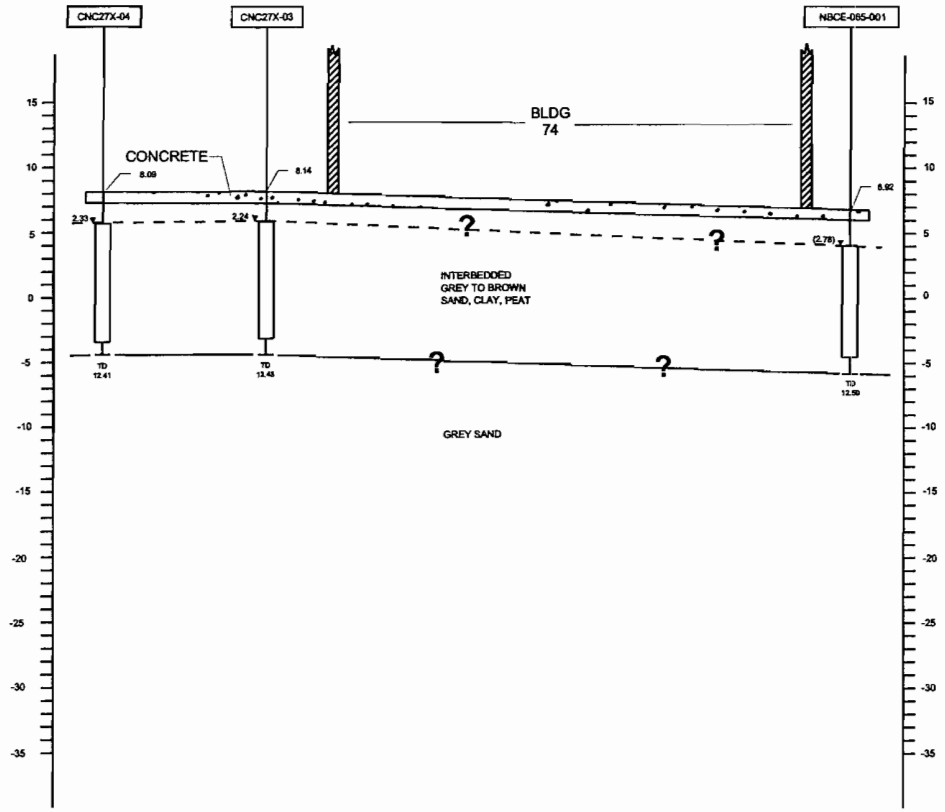
GEOLOGIC CROSS SECTION A - A'
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0126	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 4	REV. 0

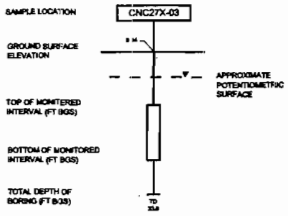
D:\CHARLESTON\CNC_SITE27.APR 18-NOV-99 JAS LAYOUT: SITE27FIG5

B
NORTHEAST

B'
SOUTHWEST



LEGEND



(2.78) ESTIMATED WATER TABLE ELEVATION

NOTES:

ND=NO DATA
ELEVATION IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)

HORIZONTAL SCALE IN FEET

VERTICAL SCALE IN FEET

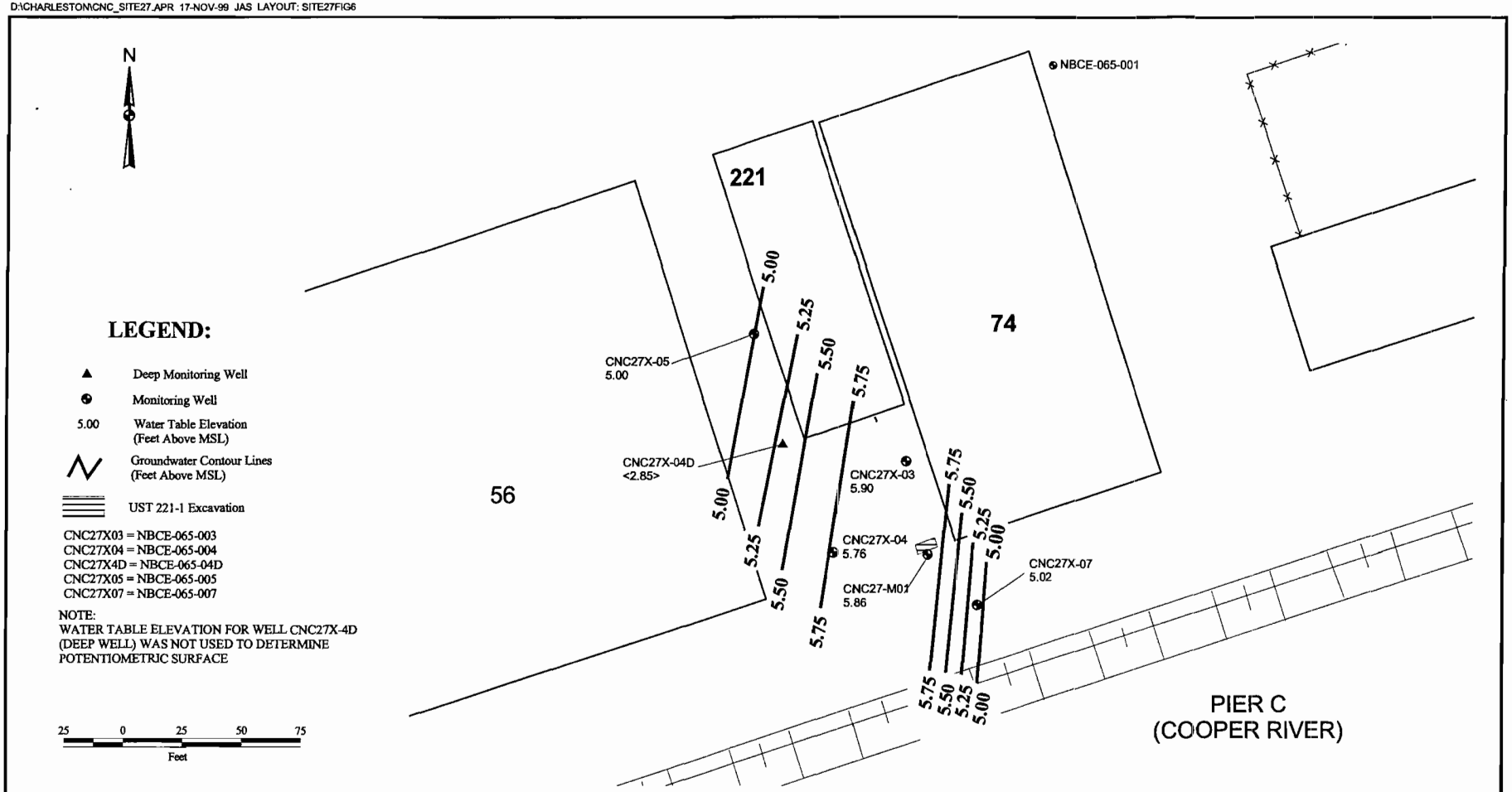
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY JAS — DATE 11-18-99
CHECKED BY — DATE
COST/SCHED-AREA
SCALE AS NOTED

GEOLOGIC CROSS SECTION B - B'
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0126
APPROVED BY — DATE
APPROVED BY — DATE
DRAWING NO. FIGURE 5
REV. 0

D:\CHARLESTON\CNC_SITE27.APR 17-NOV-99 JAS LAYOUT: SITE27FIG6



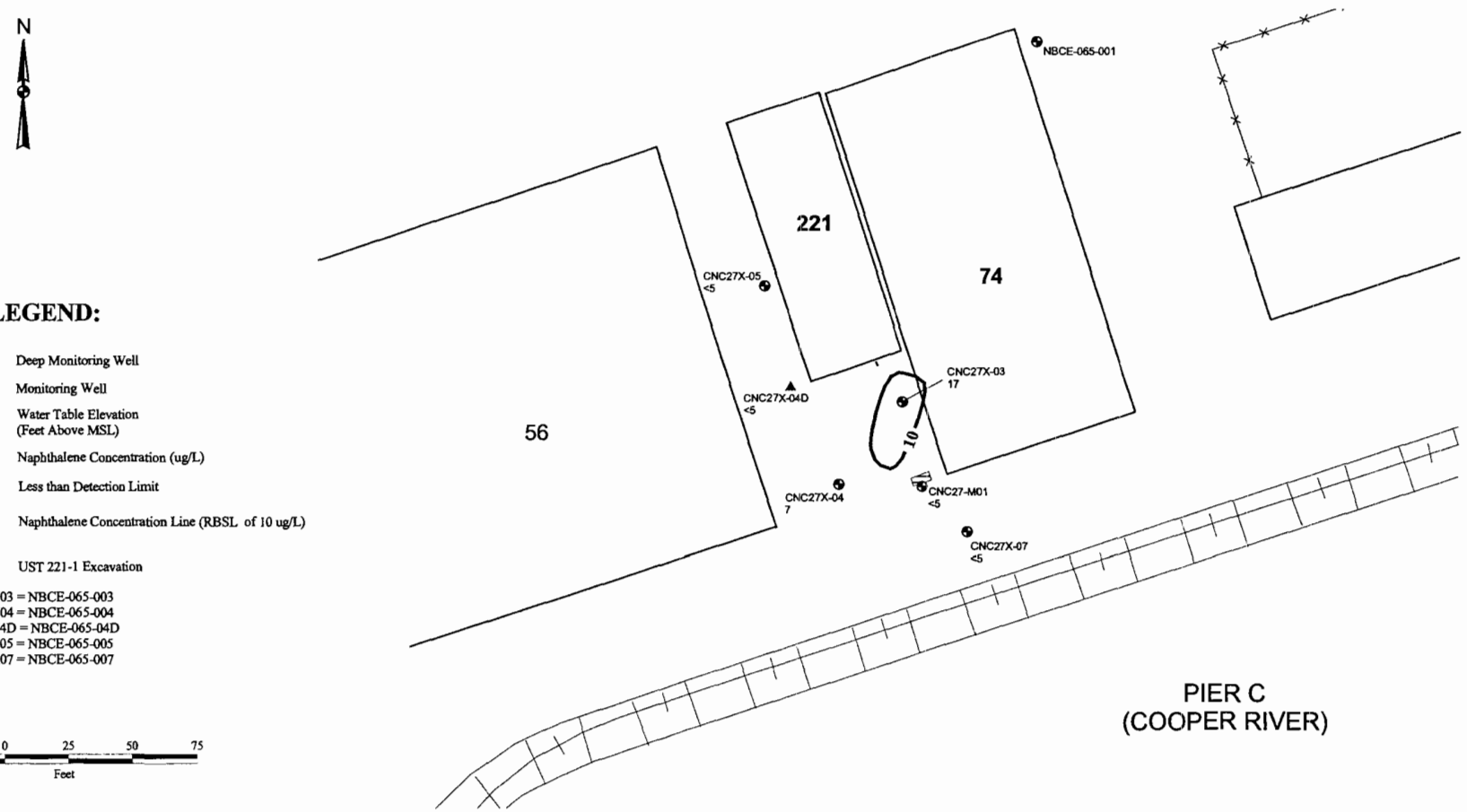
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY JAS DATE 11-17-99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

GROUNDWATER POTENTIOMETRIC SURFACE MAP
(SEPTEMBER 23, 1999)
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0126
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 6
REV. 0

D:\CHARLESTON\CNC_SITE27.APR 17-NOV-99 JAS LAYOUT: SITE27FIG7



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY JAS	DATE 11-17-99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	

NAPHTHALENE CONCENTRATIONS
IN GROUNDWATER
SITE 27, BUILDING 221
ZONE, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0126	
APPROVED BY	DATE
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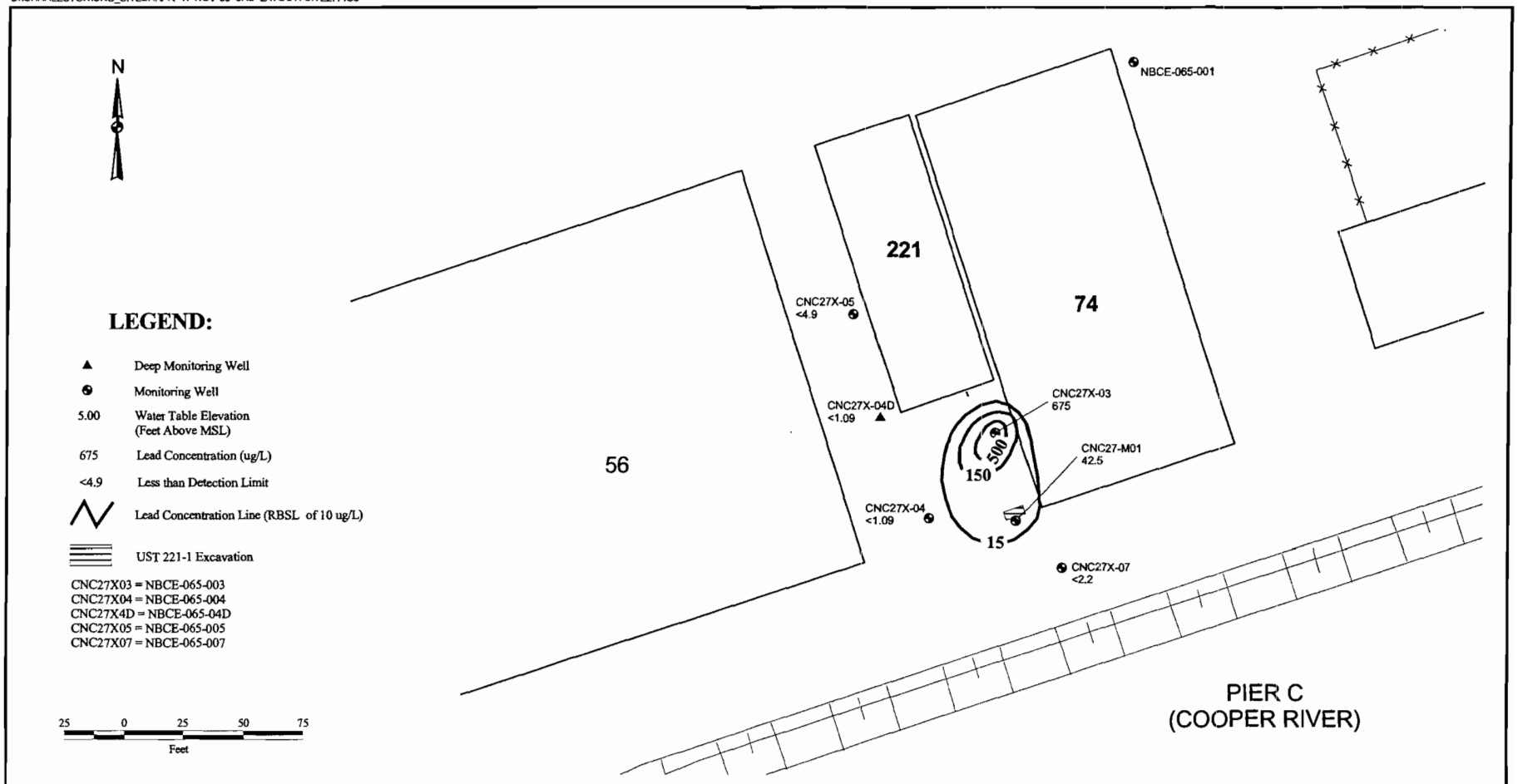
DRAWING NO. FIGURE 7	REV. 0

D:\CHARLESTON\CNC_SITE27.APR 17-NOV-99 JAS LAYOUT: SITE27FIG8



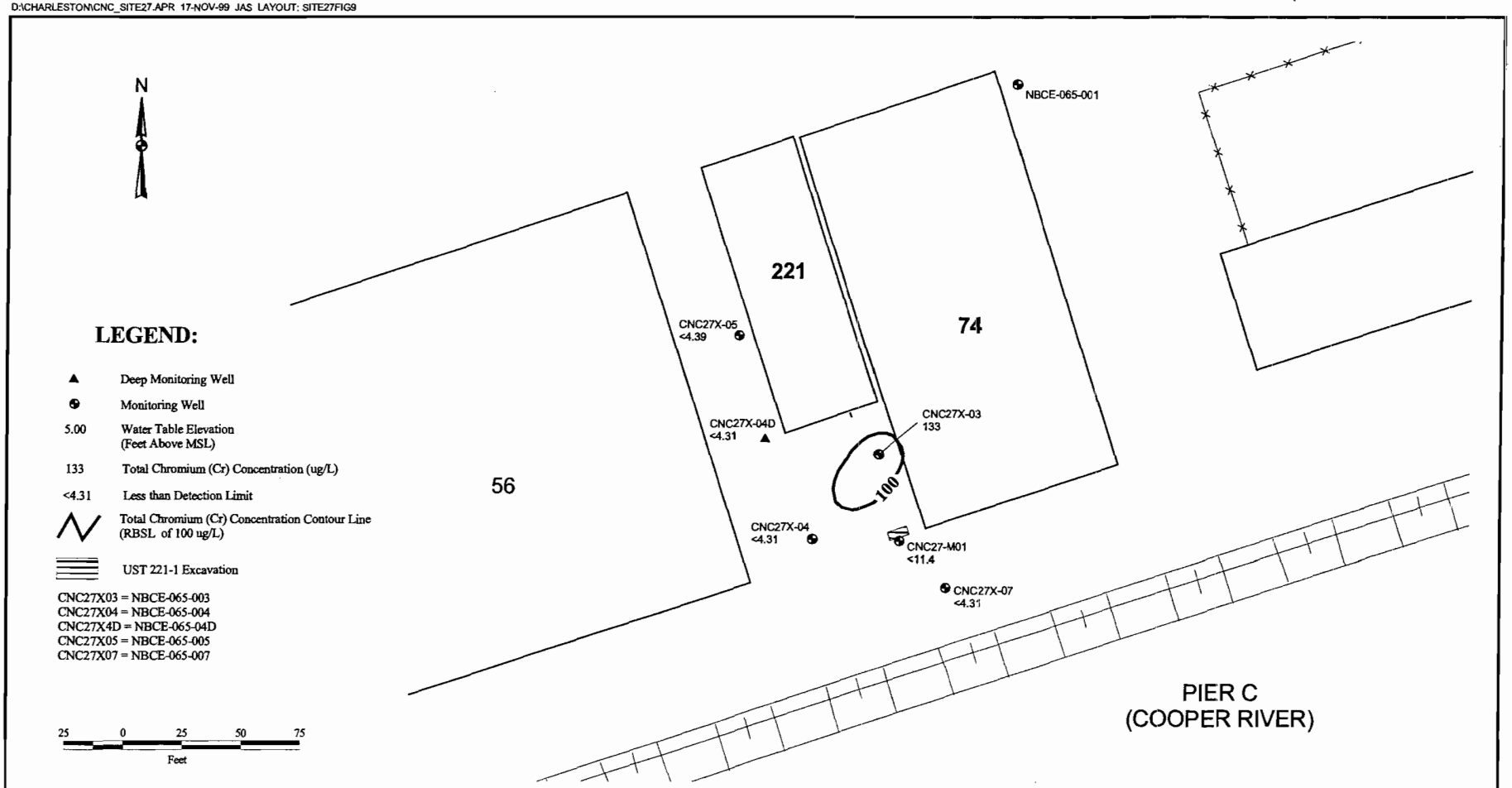
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY JAS	DATE 11-17-99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	

LEAD CONCENTRATIONS IN GROUNDWATER
SITE, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUH CAROLINA

CONTRACT NO. 0126	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 8	REV. 0

D:\CHARLESTON\CNC_SITE27.APR 17-NOV-99 JAS LAYOUT: SITE27FIG9



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY JAS DATE 11-17-99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

TOTAL CHROMIUM CONCENTRATIONS
IN GROUNDWATER
SITE 27, BUILDING 221
ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0126
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 9
REV. 0

APPENDIX A

UNDERGROUND STORAGE TANK ASSESSMENT REPORT - UST 221

South Carolina
DHEC
Department of Health and Environmental Control
2600 Bull Street, Columbia, SC 29201-1708

Mr. Gabriel L. Magwood
Southern Division NFEC
P.O. Box 190010
2155 Eagle Drive
North Charleston, South Carolina 29419-9010

Re: Assessment Report dated October 17, 1996
Charleston Naval Base Building 221 (UST 221-1) (Zone E)
(Site Identification # 17686)
Charleston County

Date: December 31, 1996

Dear Mr. Magwood:

The author has completed technical review of the referenced document. As submitted, the report provides analytical results of environmental sampling conducted to determine if releases have occurred from operation of the referenced underground storage tank and/or associated piping system. The results presented indicate low levels of petroleum hydrocarbons and elevated levels of RCRA metals (total analysis) were detected in soils and groundwater grab samples obtained from the tank pit. These results appear to necessitate additional endeavors for remedial actions (soils removal) and contamination characterization (assessment activities, including groundwater investigations), as appropriate. In this regard, assessment/corrective action activities provided in the Tank Management Plan (dated October 18, 1996) should be implemented in an appropriate and timely manner. Please be reminded that groundwater sampling (if necessary) will require construction of sampling points and will need to be submitted for prior review and approval, as appropriate.

Should you have any questions, please contact me at (803) 734-5328.

Sincerely,

Paul L. Bristol, Hydrogeologist
Groundwater Assessment and Development Section
Bureau of Water

cc: Trident District EQC

UST ASSESSMENT REPORT
UST 221-1
NAVAL BASE CHARLESTON
CHARLESTON SC

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON SC

Prepared by:

SUPERVISOR OF SHIPBUILDING, CONVERSION
AND REPAIR, USN, PORTSMOUTH DETACHMENT
ENVIROMENTAL CHARLESTON, SC
1899 NORTH HOBSON AVE.
NORTH CHARLESTON SC 29405-2106

October 17, 1996

South Carolina Department of Health and Environmental Control (S.C.D.H.E.C.)
Underground Storage Tank (UST) Assessment Report

Date Received State Use Only

Submit Completed Form to:
UST Regulatory Section
SCDHEC
2600 Bull Street
Columbia, South Carolina 29201
Telephone (803) 734-5331

I OWNERSHIP OF UST(S)

Agency/Owner: Southern Division, Naval Facilities Engineering Command, Caretaker Site Office

Mailing Address: P.O. Box 190010

City: N. Charleston State: SC Zip Code: 29419-9010

Area Code: 803 Telephone Number: 743-9985 Contact Person: LCDR Paul Rose

II SITE IDENTIFICATION AND LOCATION

Site I.D. #: Not regulated

Facility Name: Charleston Naval Base Complex, UST 221-1

Street Address: South Hobson Avenue

City: North Charleston, 29405-2413 County: Charleston

III CLOSURE INFORMATION

Closure Started: 14 June 1996 Closure Completed: 18 June 1996

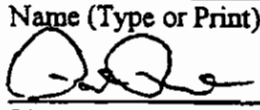
Number of USTs Closed: 1

N/A	SPORTENVDETCHASN
Consultant	UST Removal Contractor

IV. CERTIFICATION (Read and Sign after completing entire submittal)

I certify that I have personally examined and am familiar with the information submitted in this and all attached documents; and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate and complete.

LCDR Paul Rose
Name (Type or Print)



Signature

V. UST INFORMATION

		Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
A.	Product.....	Waste Oil					
B.	Capacity.....	280gal.					
C.	Age.....	> 20 yrs.					
D.	Construction Material.....	Steel					
E.	Month/Year of Last Use.....	1984					
F.	Depth (ft.) To Base of Tank.....	5'					
G.	Spill Prevention Equipment Y/N.....	N					
H.	Overfill Prevention Equipment Y/N.....	N					
I.	Method of Closure Removed/Filled.....	R					
J.	Visible Corrosion or Pitting Y/N.....	N					
K.	Visible Holes Y/N.....	N					

L. Method of disposal for any USTs removed from the ground (attach disposal manifests)

The UST was removed from the ground, drained, and cleaned. It was then cut up for recycling as scrap metal. See Attachment III.

M. Method of disposal for any liquid petroleum, sludges, or waste waters removed from the USTs (attach disposal manifests)

The residual waste oil was recycled.

N. If any corrosion, pitting, or holes were observed, describe the location and extent for each UST

The tank was in good condition. No corrosion, pitting, or holes were observed.

VI. PIPING INFORMATION

		Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
A.	Construction Material.....	Steel					
B.	Distance from UST to Dispenser.....	5'					
C.	Number of Dispensers.....	1					
D.	Type of System P/S.....	N/A*					
E.	Was Piping Removed from the Ground? Y/N....	Y					
F.	Visible Corrosion or Pitting Y/N.....	N					
G.	Visible Holes Y/N.....	N					
H.	Age.....	> 20 years					

* UST 221-1was a gravity fed holding tank for an oily water separator. It was periodically emptied by suction.

I. If any corrosion, pitting, or holes were observed, describe the location and extent for each line.

Pipes were mildly corroded, but overall in good condition. However, the feed pipe from the separator to the UST had a loose mechanical connection at the UST.

VII. BRIEF SITE DESCRIPTION AND HISTORY

Bldg 221 is a former pickling plant and galvanizing shop located inside the Controlled Industrial Area of the Charleston Naval Shipyard. Building 221 was part of the Bldg 56, Pipe Shop area. The oil/water separator and tank system at the Bldg 221 site was part of a steam cleaning pad. The pad was used for cleaning oily/greasy parts and components. A drain in the pad emptied into the oil/water separator. In 1983-1984 the operation was shut down.

Most of the water present in the Attachment I photographs is the result of a leaking water pipe adjacent to Building 74. See Attachment I.

VIII. SITE CONDITIONS

		Yes	No	Unk
A.	Were any petroleum-stained or contaminated soils found in the UST excavation, soil borings, trenches, or monitoring wells? If yes, indicate depth and location on the site map.		X	
B.	Were any petroleum odors detected in the excavation, soil borings, trenches, or monitoring wells? If yes, indicate location on site map and describe the odor (strong, mild, etc.)		X	
C.	Was water present in the UST excavation, soil borings, or trenches? If yes, how far below land surface (indicate location and depth)? GW was 6" deep throughout the excavation, GSL 5'	X		
D.	Did contaminated soils remain stockpiled on site after closure? If yes, indicate the stockpile location on the site map. Name of DHEC representative authorizing soil removal: _____		X	
E.	Was a petroleum sheen or free product detected on any excavation or boring waters? If yes, indicate location and thickness. [* sheen]	X*		

IX. SAMPLE INFORMATION

S.C.D.H.E.C. Lab Certification Number 10120

Sample #	Location	Sample Type (Soil/Water)	Depth*	Date/Time of Collection	Collected By	OVA#
SPORT 0080-1	Bottom center of excavation.	Water	5'	6/17/96 1430	R. Atkins	Not Taken
SPORT 0080-2	West end of tank.	Soil	3'	6/17/96 1430	R. Atkins	Not Taken
SPORT 0080-3	East end of tank.	Soil	3'	6/17/96 1430	R. Atkins	Not Taken

* = Depth Below the Surrounding Land Surface

X. SAMPLING METHODOLOGY

Provide a detailed description of the methods used to collect and store (preserve) the samples.

After the removal of UST 221-1 soil and ground water samples were taken. Sampling was performed in accordance with SC DHEC R.61-92 Part 280 and SC DHEC UST Assessment Guidelines.

The samples are identified as follows:

	Detachment Charleston		General Engineering Labs
Ground Water Sample	UST221-1	=	SPORT -0080-1
Soil Sample	UST221-2	=	SPORT -0080-2
Soil Sample	UST221-3	=	SPORT -0080-3

Sample jars were prepared by the testing laboratory. The grab method was utilized to fill the sample containers leaving as little head space as possible and immediately capped. Soil samples were extracted at the tank ends just above the ground water level. The ground water sample was taken from the bottom center of the excavation.

The samples were marked, logged, and immediately placed in sample coolers packed with ice to maintain an approximate temperature of 4° C. Tools were thoroughly cleaned and decontaminated with organic-free soap and water after each sample.

The samples remained in the custody of SPORTENVDETCHASN until they were transferred to General Engineering Laboratories for analysis as documented in the attached Chain-of-Custody Record.

XI. RECEPTORS

		Yes	No
A.	Are there any lakes, ponds, streams, or wetlands located within 1000 feet of the UST system? [*Cooper River 103'] If yes, indicate type of receptor, distance, and direction on site map.	X*	
B.	Are there any public, private, or irrigation water supply wells within 1000 feet of the UST system? If yes, indicate type of well, distance, and direction on site map.		X
C.	Are there any underground structures (e.g., basements) located within 100 feet of the UST system? If yes, indicate the type of structure, distance, and direction on site map.		X
D.	Are there any underground utilities (e.g., telephone, electricity, gas, water, sewer, storm drain) located within 100 feet of the UST system that could potentially come in contact with the contamination? [*water, storm drain] If yes, indicate the type of utility, distance, and direction on the site map.	X*	
E.	Has contaminated soil been identified at a depth of less than 3 feet below land surface in an area that is not capped by asphalt or concrete? If yes, indicate the area of contaminated soil on the site map.		X

Attachment I

SITE MAP

You must supply a scaled site map. It should include all buildings, road names, utilities, tank and pump island locations, sample locations, extent of excavation, and any other pertinent information.

Site Maps 1, 2, and 3
Photographs 1, 2, and 3

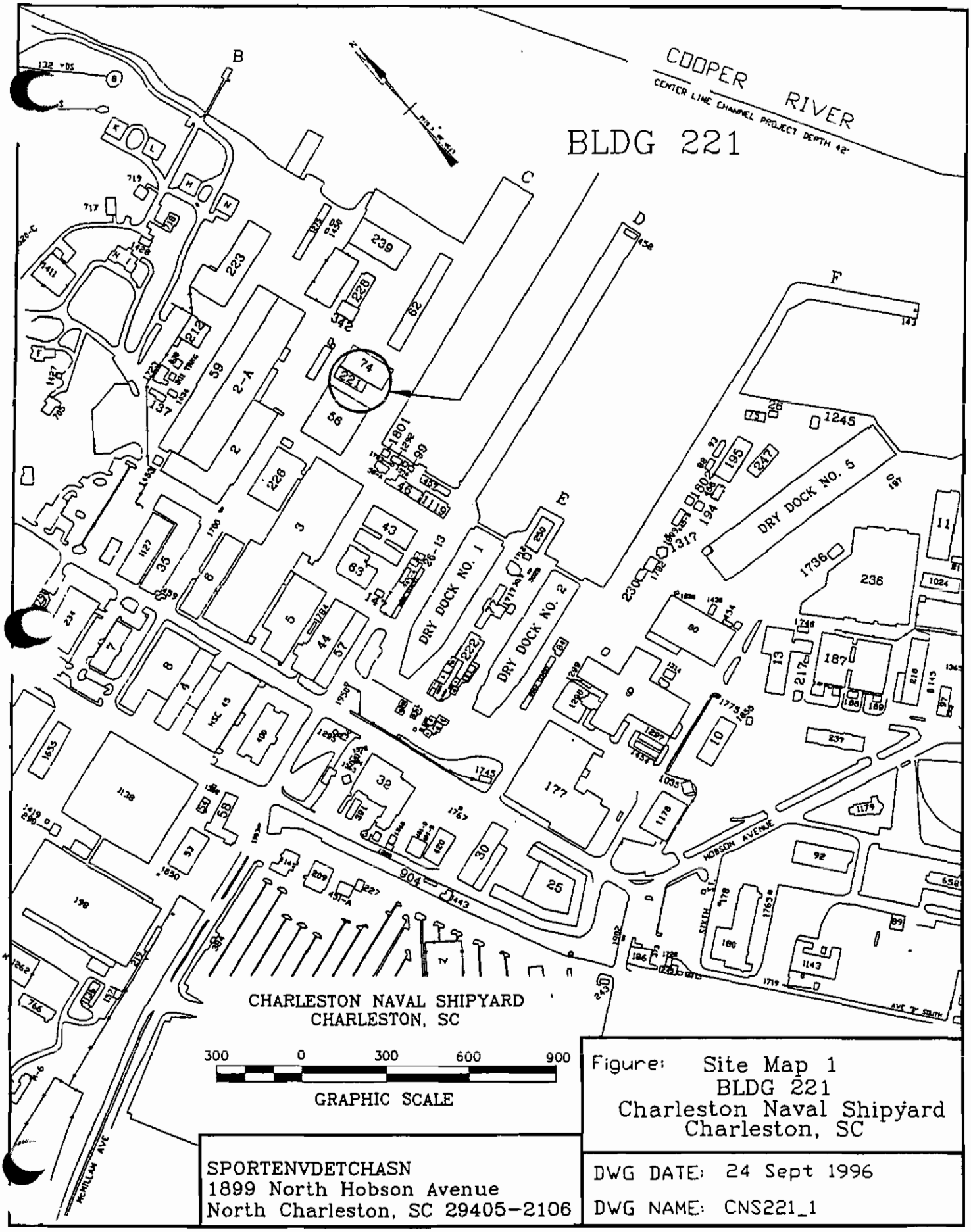
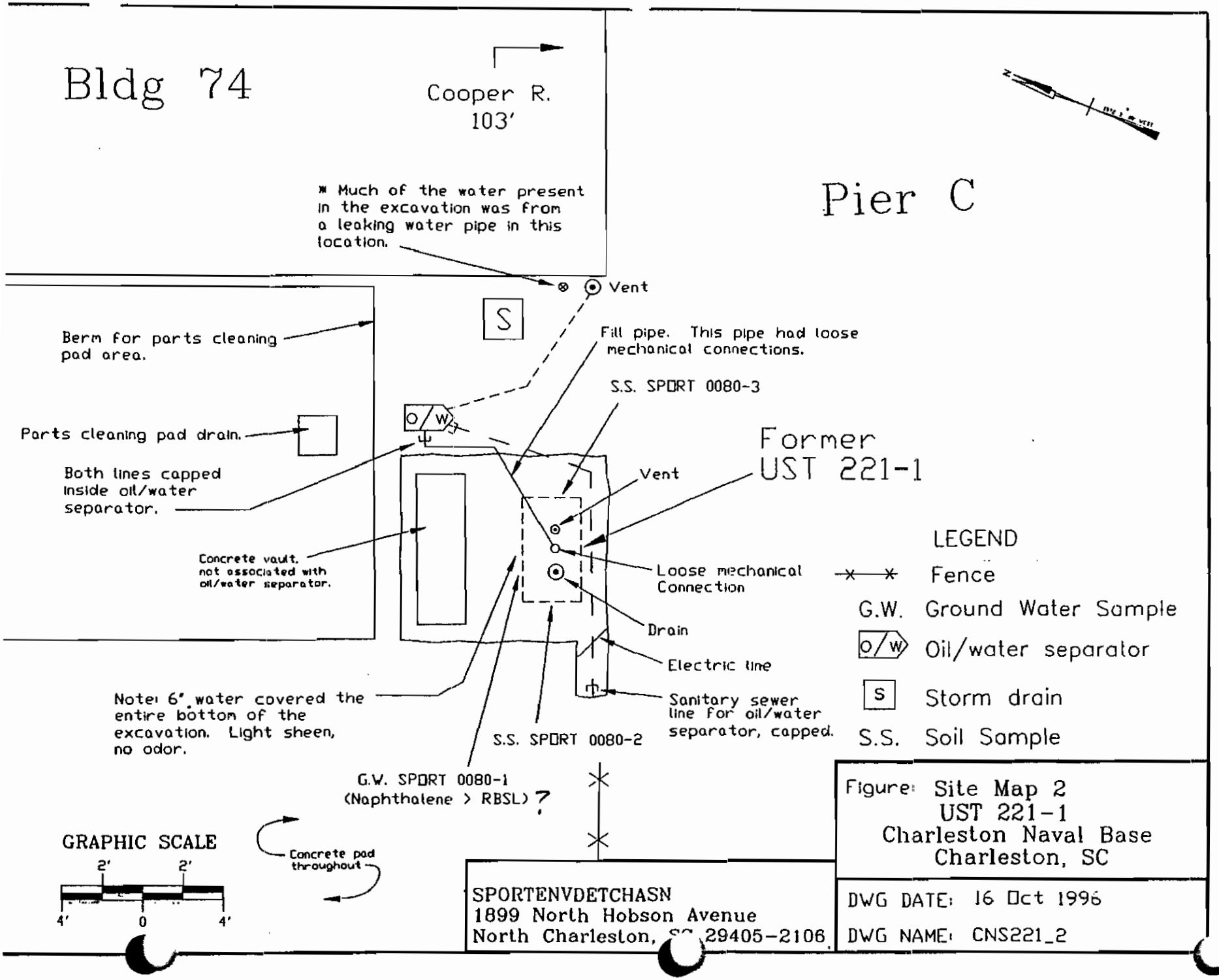


Figure: Site Map 1
BLDG 221
Charleston Naval Shipyard
Charleston, SC

SPORTENVDETCHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106

DWG DATE: 24 Sept 1996

DWG NAME: CNS221_1


Bldg 74
Cooper R.
103'
Pier C
* Much of the water present in the excavation was from a leaking water pipe in this location.
Vent
S
Fill pipe. This pipe had loose mechanical connections.
S.S. SPORT 0080-3
Berm for parts cleaning pad area.
O/W
Parts cleaning pad drain.
Both lines capped inside oil/water separator.
Former UST 221-1
Vent
Concrete vault, not associated with oil/water separator.
Loose mechanical Connection
Drain
Electric line
Sanitary sewer line for oil/water separator, capped.
Note: 6" water covered the entire bottom of the excavation. Light sheen, no odor.
S.S. SPORT 0080-2
G.W. SPORT 0080-1
(Naphthalene > RBSL) ?
Concrete pad throughout
GRAPHIC SCALE
2' 2'
4' 0 4'
LEGEND
Fence
G.W. Ground Water Sample
O/W Oil/water separator
S Storm drain
S.S. Soil Sample
SPORTENVDETCHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106
Figure: Site Map 2
UST 221-1
Charleston Naval Base
Charleston, SC
DWG DATE: 16 Oct 1996
DWG NAME: CNS221_2

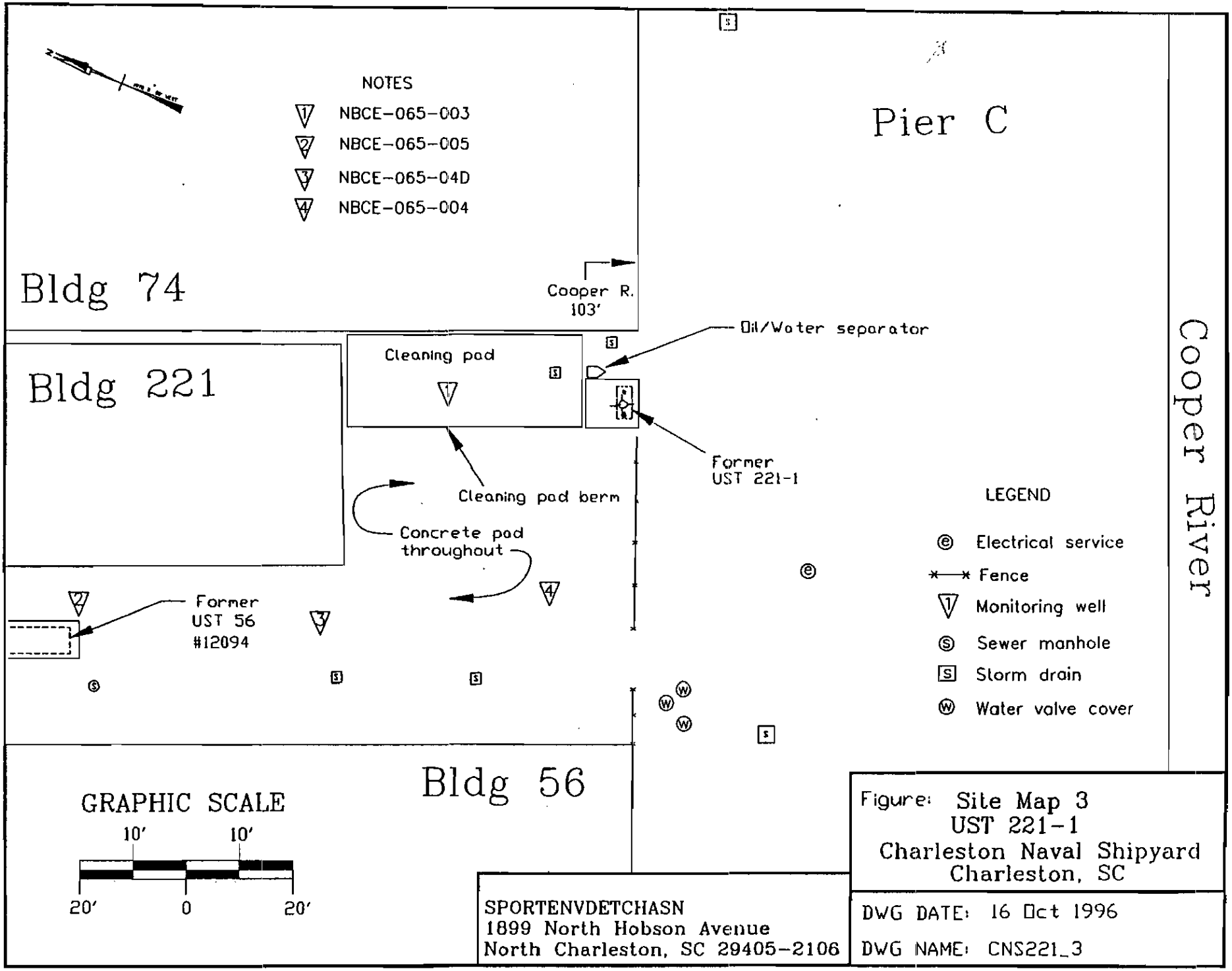


Figure: Site Map 3
UST 221-1
Charleston Naval Shipyard
Charleston, SC

SPORTENVDETCHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106

DWG DATE: 16 Oct 1996

DWG NAME: CNS221_3

Photo 2: UST 221 being removed.

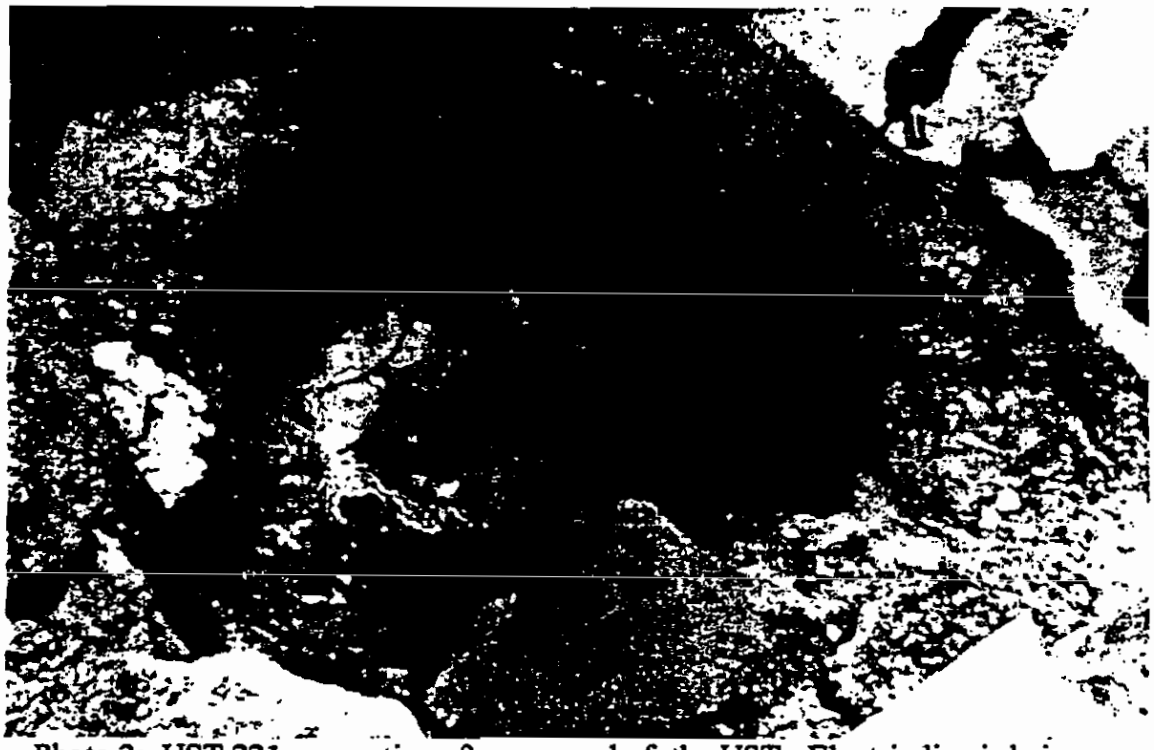


Photo 2: UST 221 excavation after removal of the UST. Electric line is being indicated.

UST 221

Photo 1: UST 221-1 before removal.

Attachment II

ANALYTICAL RESULTS

You must submit the laboratory report and chain-of-custody form for the samples. These samples must be analyzed by a South Carolina certified laboratory.

Certified Analytical Results
Chain-of-Custody

GENERAL ENGINEERING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-1
Lab ID : 9606324-01
Matrix : GroundH2O
Date Collected : 06/17/96
Date Received : 06/18/96
Priority : Routine
Collector : Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Volatile Organics											
BTEX - 4 items											
Benzene	U	0.00	1.00	2.00	ug/l	1.0	RMB	06/21/96	1058	86230	1
Ethylbenzene		4.90	1.00	2.00	ug/l	1.0					
Toluene	U	0.00	1.00	2.00	ug/l	1.0					
Xylenes (TOTAL)		18.7	1.00	4.00	ug/l	1.0					
Naphthalene		34.7	1.00	2.00	ug/l	1.0					
Extractable Organics											
Polynuclear Aromatic Hydrocarbons - 16 items											
Acenaphthene	U	0.00	5.00	10.0	ug/l	1.0	BDG	06/25/96	1950	86220	2
Acenaphthylene	U	0.00	5.00	10.0	ug/l	1.0					
Anthracene	U	0.00	5.00	10.0	ug/l	1.0					
Benzo(a)anthracene	U	0.00	5.00	10.0	ug/l	1.0					
Benzo(a)pyrene	U	0.00	5.00	10.0	ug/l	1.0					
Benzo(b)fluoranthene	U	0.00	5.00	10.0	ug/l	1.0					
Benzo(ghi)perylene	U	0.00	5.00	10.0	ug/l	1.0					
Benzo(k)fluoranthene	U	0.00	5.00	10.0	ug/l	1.0					
Chrysene	U	0.00	5.00	10.0	ug/l	1.0					
Dibenzo(a,h)anthracene	U	0.00	5.00	10.0	ug/l	1.0					
Fluoranthene	U	0.00	5.00	10.0	ug/l	1.0					
Fluorene	U	0.00	5.00	10.0	ug/l	1.0					
Indeno(1,2,3-c,d)pyrene	U	0.00	5.00	10.0	ug/l	1.0					
Naphthalene		10.4	5.00	10.0	ug/l	1.0					
Phenanthrene	U	0.00	5.00	10.0	ug/l	1.0					
Pyrene	U	0.00	5.00	10.0	ug/l	1.0					
Metals Analysis											
Mercury	J	0.225	0.0148	0.500	ug/l	1.0	RMJ	06/20/96	1312	86170	N
Silver	J	2.68	2.49	10.0	ug/l	1.0	NRM	06/21/96	2338	86194	3
Arsenic		13.4	1.86	10.0	ug/l	1.0					

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CERTIFICATE OF ANALYSIS

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106

Contact: Mr. Bill Hiers

Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-1

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Barium		133	0.0663	10.0	ug/l	1.0					
Cadmium		5.30	0.0970	5.00	ug/l	1.0	NRM	06/21/96	2338	86194	3
Chromium		221	0.596	10.0	ug/l	1.0					
Lead		527	1.13	5.00	ug/l	1.0					
Selenium	J	4.30	1.43	5.00	ug/l	1.0					
General Chemistry											
Total Rec. Petro. Hydrocarbons		9.08	2.00	2.00	mg/l	1.0	JEN	06/24/96	1025	86317	4

The following prep procedures were performed:

GC/MS Base/Neutral Compounds	GWL	06/20/96	1600	86220	5
Mercury	RMJ	06/19/96	1230	86170	6
TRACE	FGD	06/20/96	1530	86194	7

Surrogate Recovery	Test	Percent%	Acceptable Limits
2-Fluorobiphenyl	M610	58.6	(43.0 - 108.)
Nitrobenzene-d5	M610	56.0	(35.0 - 111.)
p-Terphenyl-d14	M610	49.8	(33.0 - 125.)
Bromofluorobenzene	BTEX-8260	88.8	(80.0 - 128.)
Dibromofluoromethane	BTEX-8260	103.	(67.7 - 135.)
Toluene-d8	BTEX-8260	98.8	(76.8 - 122.)
Bromofluorobenzene	NAP-8260	88.8	(80.0 - 128.)
Dibromofluoromethane	NAP-8260	103.	(67.7 - 135.)
Toluene-d8	NAP-8260	98.8	(76.8 - 122.)

M = Method	Method-Description
M1	EPA 8260
M2	EPA 8270
M3	EPA 6010A
M4	EPA 9070A
M5	EPA 3510

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1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NFWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-1

M = Method	Method-Description
M 6	EPA 7470
M 7	EPA 3005

Notes:
e qualifiers in this report are defined as follows:
dicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
indicates that the analyte was not detected at a concentration greater than the detection limit.
ndicate that a quality control analyte recovery is outside of specified acceptance criteria.

GEL Laboratory Certifications		KPI Laboratory Certifications	
AL - 41040	AZ - AZ0514	AL - 41050	AZ - AZ0514
CA - 2089	CT - PH-0169	CA - I-1023/2056	CT - PH-0175
DE - SC012	FL - E87156/87294	FL - E87472/87458	MS - 29417
ME - SC012	MS - 10120	NY - 11502	RI - 138
NC - 233	NY - 11501	SC - 10582	TN - 02934
RI - 135	SC - 10120	UT - E-227	VA - 00111
TN - 02934	UT - E-251	WA - C225	NJ - 79002
VA - 00151	WA - C223	PA - 68-485	WV - 235
WI - 999887790			

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1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-1

GEL Laboratory Certifications EPI Laboratory Certifications

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Karen Blakeney at (803) 769-7386.

Karen Blakeney
Analytical Report Specialist

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1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-2
Lab ID : 9606324-02
Matrix : Soil
Date Collected : 06/17/96
Date Received : 06/18/96
Priority : Routine
Collector : Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Volatile Organics											
BTEX - 4 items											
Benzene	U	0.00	1.00	2.00	ug/kg	1.0	JAC	06/19/96	0943	86165	1
Ethylbenzene	J	1.30	1.00	2.00	ug/kg	1.0					
Toluene	U	0.00	1.00	2.00	ug/kg	1.0					
Xylenes (TOTAL)		6.50	1.00	4.00	ug/kg	1.0					
Naphthalene		4.70	1.00	2.00	ug/kg	1.0					
Extractable Organics											
Polynuclear Aromatic Hydrocarbons - 16 items											
Acenaphthene	U	0.00	1650	3300	ug/kg	10.	JCB	06/25/96	2032	86390	2
Acenaphthylene	U	0.00	1650	3300	ug/kg	10.					
Anthracene	U	0.00	1650	3300	ug/kg	10.					
Benzo(a)anthracene	U	0.00	1650	3300	ug/kg	10.					
Benzo(a)pyrene	U	0.00	1650	3300	ug/kg	10.					
Benzo(b)fluoranthene	U	0.00	1650	3300	ug/kg	10.					
Benzo(ghi)perylene	U	0.00	1650	3300	ug/kg	10.					
Benzo(k)fluoranthene	U	0.00	1650	3300	ug/kg	10.					
Chrysene	U	0.00	1650	3300	ug/kg	10.					
Dibenzo(a,h)anthracene	U	0.00	1650	3300	ug/kg	10.					
Fluoranthene	U	0.00	1650	3300	ug/kg	10.					
Fluorene	U	0.00	1650	3300	ug/kg	10.					
Indeno(1,2,3-c,d)pyrene	U	0.00	1650	3300	ug/kg	10.					
Naphthalene	U	0.00	1650	3300	ug/kg	10.					
Phenanthrene	U	0.00	1650	3300	ug/kg	10.					
Pyrene	U	0.00	1650	3300	ug/kg	10.					
Metals Analysis											
Mercury		0.410	0.00243	0.200	mg/kg	1.0	RMJ	06/21/96	1604	86172	N
Silver		882	123	500	ug/kg	1.0	WCC	06/21/96	1404	86195	3
Arsenic		2120	92.1	500	ug/kg	1.0					

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Client: Supervisor of Ship Building & Conversion
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1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hicks
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00195 Report Date: June 27, 1996

Sample ID : SPORT0080-2

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Barium		33300	3.28	500	ug/kg	1.0					
Cadmium		2000	4.80	250	ug/kg	1.0	WCC	06/21/96	1404	86195	3
Chromium		68200	29.5	500	ug/kg	1.0					
Lead		259000	55.9	250	ug/kg	1.0					
Selenium		321	70.8	250	ug/kg	1.0					
General Chemistry											
Total Rec. Petro. Hydrocarbons		400	10.0	50.0	mg/kg	1.0	JEN	06/26/96	1200	86423	4

The following prep procedures were performed:

GC/MS Base/Neutral Compounds	GWL	06/25/96	1630	86390	5
Mercury	RMJ	06/20/96	1500	86172	6
TRACE	DVW	06/20/96	1745	86195	7

Comments:
A dilution was required for Extractable Organics due to matrix interference. As a result, the detection limits are elevated.

Surrogate Recovery	Test	Percent%	Acceptable Limits
2-Fluorobiphenyl	M610	0.00*	(30.0 - 115.)
Nitrobenzene-d5	M610	0.00*	(23.0 - 120.)
p-Terphenyl-d14	M610	0.00*	(37.3 - 128.)
Bromofluorobenzene	BTEX-8260	108.	(59.7 - 159.)
Dibromofluoromethane	BTEX-8260	101.	(74.0 - 128.)
Toluene-d8	BTEX-8260	98.0	(53.4 - 163.)
Bromofluorobenzene	NAP-8260	108.	(59.7 - 159.)
Dibromofluoromethane	NAP-8260	101.	(74.0 - 128.)
Toluene-d8	NAP-8260	98.0	(53.4 - 163.)

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Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NFWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-2

M = Method	Method-Description
M 1	EPA 8260
M 2	EPA 8270
M 3	EPA 6010A
M 4	EPA 9071
M 5	EPA 3550
M 6	EPA 7471
M 7	EPA 3050

Notes:
The qualifiers in this report are defined as follows:
J indicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
U indicates that the analyte was not detected at a concentration greater than the detection limit.
* indicate that a quality control analyte recovery is outside of specified acceptance criteria.

GEL Laboratory Certifications		EPI Laboratory Certifications	
AL - 41040	AZ - AZ0514	AL - 41050	AZ - AZ0514
CA - 2089	CT - PH-0169	CA - I-1023/2056	CT - PH-0175
DE - SC012	FL - E87156/87294	FL - E87472/87458	MS - 29417
ME - SC012	MS - 10120	NY - 11502	RI - 138
NC - 233	NY - 11501	SC - 10582	TN - 02934
RI - 135	SC - 10120	UT - E-227	VA - 00111
TN - 02934	UT - E-251	WA - C225	NJ - 79002

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SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hines
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-2

GEL Laboratory Certifications		EPI Laboratory Certifications	
VA - 00151	WA - C223	PA - 68-485	WV - 235
WI - 999887790			

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Karen Blakeney at (803) 769-7386.

Karen Blakeney
Analytical Report Specialist

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1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996 Page 1 of 4

Sample ID : SPORT0080-3
Lab ID : 9606324-03
Matrix : Soil
Date Collected : 06/17/96
Date Received : 06/18/96
Priority : Routine
Collector : Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Volatile Organics											
BTEX - 4 items											
Benzene	U	0.00	1.00	2.00	ug/kg	1.0	JAC	06/19/96	1303	86165	1
Ethylbenzene	U	0.590	1.00	2.00	ug/kg	1.0					
Toluene	U	0.00	1.00	2.00	ug/kg	1.0					
Xylenes (TOTAL)	J	2.70	1.00	4.00	ug/kg	1.0					
Naphthalene	U	0.740	1.00	2.00	ug/kg	1.0					
Extractable Organics											
Polynuclear Aromatic Hydrocarbons - 16 items											
Acenaphthene	U	0.00	650	1300	ug/kg	4.0	JCB	06/25/96	2104	86390	2
Acenaphthylene	U	0.00	650	1300	ug/kg	4.0					
Anthracene	U	0.00	650	1300	ug/kg	4.0					
Benzo(a)anthracene	U	0.00	650	1300	ug/kg	4.0					
Benzo(a)pyrene	U	0.00	650	1300	ug/kg	4.0					
Benzo(b)fluoranthene	U	0.00	650	1300	ug/kg	4.0					
Benzo(ghi)perylene	U	0.00	650	1300	ug/kg	4.0					
Benzo(k)fluoranthene	U	0.00	650	1300	ug/kg	4.0					
Chrysene	U	0.00	650	1300	ug/kg	4.0					
Dibenzo(a,h)anthracene	U	0.00	650	1300	ug/kg	4.0					
Fluoranthene	U	0.00	650	1300	ug/kg	4.0					
Fluorene	U	0.00	650	1300	ug/kg	4.0					
Indeno(1,2,3-c,d)pyrene	U	0.00	650	1300	ug/kg	4.0					
Naphthalene	U	0.00	650	1300	ug/kg	4.0					
Phenanthrene	U	0.00	650	1300	ug/kg	4.0					
Pyrene	U	0.00	650	1300	ug/kg	4.0					
Metals Analysis											
Mercury	J	0.0538	0.00215	0.200	mg/kg	1.0	RMJ	06/21/96	1606	86172	N
Silver	J	281	125	500	ug/kg	1.0	WCC	06/21/96	1409	86195	3
Arsenic		1290	93.0	500	ug/kg	1.0					

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

CERTIFICATE OF ANALYSIS

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106

Contact: Mr. Bill Hiers

Project Description: SUPSHIP-Portsmouth Detachment

NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-3

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Barium		21200	3.32	500	ug/kg	1.0					
Cadmium		631	4.85	250	ug/kg	1.0	WCC	06/21/96	1409	86195	3
Chromium		39200	29.8	500	ug/kg	1.0					
Lead		81100	56.5	250	ug/kg	1.0					
Selenium		389	71.5	250	ug/kg	1.0					
General Chemistry											
Total Rec. Petro. Hydrocarbons		115	10.0	50.0	mg/kg	1.0	JEN	06/26/96	1200	86423	4

The following prep procedures were performed:

GC/MS Base/Neutral Compounds	GWL	06/25/96	1630	86390	5
Mercury	RMJ	06/20/96	1500	86172	6
TRACE	DVW	06/20/96	1745	86195	7

Comments:
A dilution was required for Extractable Organics due to matrix interference. As a result, the detection limits are elevated.

Surrogate Recovery	Test	Percent%	Acceptable Limits
2-Fluorobiphenyl	M610	89.0	(30.0 - 115.)
Nitrobenzene-d5	M610	57.7	(23.0 - 120.)
p-Terphenyl-d14	M610	97.0	(37.3 - 128.)
Bromofluorobenzene	BTEX-8260	104.	(59.7 - 159.)
Dibromofluoromethane	BTEX-8260	101.	(74.0 - 128.)
Toluene-d8	BTEX-8260	95.6	(53.4 - 163.)
Bromofluorobenzene	NAP-8260	104.	(59.7 - 159.)
Dibromofluoromethane	NAP-8260	101.	(74.0 - 128.)
Toluene-d8	NAP-8260	95.6	(53.4 - 163.)

P O Box 30712 • Charleston, SC 29417 • (803) 556-8171 • Fax (803) 766-1178

GENERAL ENGINEERING LABORATORIES

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CERTIFICATE OF ANALYSIS

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-3

M = Method	Method-Description
M1	EPA 8260
M2	EPA 8270
M3	EPA 6010A
M4	EPA 9071
M5	EPA 3550
M6	EPA 7471
M7	EPA 3050

otes:
The qualifiers in this report are defined as follows:
J indicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
U indicates that the analyte was not detected at a concentration greater than the detection limit.
* indicate that a quality control analyte recovery is outside of specified acceptance criteria.

GEL Laboratory Certifications		EPI Laboratory Certifications	
AL - 41040	AZ - AZ0514	AL - 41050	AZ - AZ0514
CA - 2089	CT - PH-0169	CA - I-1023/2056	CT - PH-0175
DE - SC012	FL - E87156/87294	FL - E87472/87458	MS - 29417
ME - SC012	MS - 10120	NY - 11502	RI - 138
NC - 233	NY - 11501	SC - 10582	TN - 02954
RI - 135	SC - 10120	UT - E-227	VA - 00111
TN - 02934	UT - E-251	WA - C225	NJ - 79002

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Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00196 Report Date: June 27, 1996

Sample ID : SPORT0080-3

GEL Laboratory Certifications		EPI Laboratory Certifications	
VA - 00151	WA - C223	PA - 68-485	WV - 235
WI - 999887790			

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Karen Blakeney at (803) 769-7386.

Karen Blakeney

Analytical Report Specialist

P O Box 30712 • Charleston, SC 29417 • (803) 556-8171 • Fax (803) 766-1178

00196

CHAIN OF CUSTODY RECORD

General Engineering ories, Inc.
2040 Savage Road
Charleston, South Car
P.O. Box 30712
Charleston, South Carolina 29417
(803) 556-8171

Page 1 of 1 9606324

Client Name/Facility Name: SPORTENVDETCHASN
Collected by/Company: SPORTENVDETCHASN

Use F or P in the boxes to indicate whether sample was filtered and/or preserved

CCL 21882

SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	TOC/DOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	RCRA METALS - specify	Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type	TPH/PAH	BTEX & MTBE	Remarks	
SPORT0080-1	6/17/96	1430				X	8							X	P								X	+	UST221-1GW	.1
SPORT0080-2	6/17/96	1430		X		X	4							X									X	X	UST221-2 SOIL	.2
SPORT0080-3	6/17/96	1430		X		X	4							X									X	X	UST221-3 SOIL	.2
SPORT0080-4	6/17/96	1430		X		X	3 4							X	P								P X	X	VOA TRIP BLANK	.3

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received by:
[signature]	6/17/96	1530	[signature]	W.K. Hiers, Jr.	6/18/96	1442	[signature]
Michael Pate	6/18/96	1500	Craig Kunard		6/18/96	1300	

Remarks:

White = sample collector Yellow = file Pink = with report

Attachment III

Certificate of Disposal (tank)

UST Certificate of Disposal

CONTRACTOR

Supervisor of Shipbuilding, Conversion and Repair, USN
Portsmouth, VA
Environmental Detachment Charleston
1899 North Hobson Avenue
North Charleston 29405-2106

Telephone (803) 743-6482

TANK ID & LOCATION

UST 221-1, Bldg 221, Charleston Naval Shipyard, Charleston, SC

DISPOSAL LOCATION

Bldg. 1601 Tank Cleaning
& Disposal Area
Charleston Naval Complex

TYPE OF TANK	SIZE (GAL)
Waste Oil	280 gal.

CLEANING/DISPOSAL METHOD

The tank was cut open on both ends, cleaned with a steam cleaner, and disposed of as recyclable scrap metal.

DISPOSAL CERTIFICATION

I certify that the above tank has been properly cleaned and disposed of as recyclable scrap metal.

D.S. Elkins 9-26-96

(Name) (Date)

APPENDIX B

GEOLOGIC BORING LOGS

BORING LOG

PROJECT NAME: CWC
PROJECT NUMBER:
DRILLING COMPANY: Columbia
DRILLING RIG: Stratoprobe
BORING NUMBER: 27 MWØ1
DATE: 8/4/99
GEOLOGIST:
DRILLER: L. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	1					Brn	Sand		Dry				
	2					Brn	Gravel & Sand		Moist			.	
	3						↓		Saturated			.	
	4								↓				
	5						↓						
	6					↓	Sand						
	7					Gray	Clayey Sand			0	0	0	0
	8					↓	↓		↓				

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): 0

Remarks:

Converted to Well: Yes Y No Well I.D. #: MwØ1

BORING LOG

Page ___ of ___

CNC27B01

PROJECT NAME: CNC Site 27 BORING NUMBER: B01
PROJECT NUMBER: 10126 DATE: 5-26-99
DRILLING COMPANY: GEOLOGIST:
DRILLING RIG: Geoprobe DRILLER: B.L

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Concrete						
				1.5			Brown silty fine		Sample Soil				
				2.5			To med Sand (Moist)		2.0'-3.0'				
	4						Gray f. Sand (Wet)		Rec. 1.5	0	0		0
	7			7.0'							5000		
				B.T.									
									Soil Screen				
									4.0'-7.0'				
							W/L ≈ 4.7						
									Water Sample				
									from 4.0-7.0				
									FID# 27GFB01040				
									Time: 0923				

Soil Sampl. Time 0914 ID # 275FB01020

>5000 ppm in Borehole w/carbon filter

No odor

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: ____ Yes ____ No Well I.D. #: ____

BORING LOG

Page ___ of ___

PROJECT NAME: Site 27 — BORING NUMBER: CNC27B02
OJECT NUMBER: N0126 — DATE: 5-26-99
DRILLING COMPANY: — GEOLOGIST:
DRILLING RIG: Geoprobe — DRILLER: B.L.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Concrete		Moist				
	2			1.5 / 2.0			Brown silty clay		Soil Sample from 2.0-3.0	500			0
							Gray f. to med. Sand						
	4						(wet)		ID# 27SFB02020203				
									Time @ 1020				
							↓						
	7			7.0									
				B.T					Set Screen				
									from 4.0-7.0				
									Sampled water				
									from 4.0-7.0'				
									ID# 27GFB02020203				
							w/L = 4.65'						
							Note @ Got Bit						
							stuck in concrete						
							& had to use water						
							To wash it out.						

Rec. 2.2'

Borehole >5000 ppm w/o filter No odor

*When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes ____ No ____ Well I.D. #: _____

BORING LOG

Page ___ of ___

PROJECT NAME: Site 27
PROJECT NUMBER: N0126
DRILLING COMPANY:
DRILLING RIG: Geoprobe.
BORING NUMBER: CNC27 B03
DATE: 5-26-94
GEOLOGIST:
DRILLER: B.L.

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
				0.9			Concrete		Soil Sample	0	0		0
	2			1.5			Brown f. Sand w/some		from 1.0-2.0				
							Gravel - Wet		#27SFB03019				
	4						Gray f. Sand - Wet		Rec. 1.4'	0	0	4500	0
							↓						
	7			7.0					Sampled Water				
				B.T					4.0'-7.0'				
									Time: 1058				
									Set Screen				
									from 4.0'-7.0'				
							W/L = 3.5'						
							B		w/o w/o filter				
									= 4500 ppm				
									in Borehole				

S.S Time: 1050

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No ____ Well I.D. #: ____

BORING LOG

Page ___ of ___

PROJECT NAME: Site 27
PROJECT NUMBER:
DRILLING COMPANY:
DRILLING RIG: Geoprobe
BORING NUMBER: CNC27B04
DATE: 6-2-99
GEOLOGIST:
DRILLER: B. Lewis

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Concrete		Because concrete was ~~so~~ so thick was unable to get soil sampler down through concrete. Will set screen from 4.0'-7.0' & get water sample only				
				2.0									
	4												
	7			7.0			W/L = 2.7'						
									Sampled water # 27FB0404007 Time: 1620				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No ____ Well I.D. #: ____

BORING LOG

Page ___ of ___

PROJECT NAME: Site 27
PROJECT NUMBER:
DRILLING COMPANY:
DRILLING RIG: Geoprobe
BORING NUMBER: CNC27B05
DATE: 6-2-99
GEOLOGIST:
DRILLER: B. Lewis

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
				.5			Asphalt						
				2.5			Sand & Gravel						
				3.0'			Yellow Sandy Clay		Moist				
	4		2.9				Gray Silty Clay		Moist	0	0	0	0
							Dark Gray Med To						
							Coarse Sand w/ some						
	7			7.0			coarse gravel		Wet				
				13.T									
							W/L = 2.6'		Soil to moist				
									To get Soil Sample				
									Set Screen				
									from 4.0-7.0				
									#				
									Sampled Water				
									# 27GFB05S0407				
									Time: 1645				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No ____ Well I.D. #: ____

BORING LOG

PROJECT NAME: CNC, Forest, Site 27 BORING NUMBER: 27B06
PROJECT NUMBER: DATE: 7/18/94
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Stratoprobe DRILLER: R. Brand

Sample No. and Type or RQD	Depth (Ft.) or Run No	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency / or Rock Hardness	Color	Material Classification	USCS	Remarks	PID/FID Reading (ppm): Sample	Sample BZ	Borehole	Drilling Area
	1						Asphalt w/base						
	2						↓						
	3								Saturated				
	4												

rock coring, enter rock lithology
onite monitor reading in 5 foot intervals @ boreholes Increase reading frequency if elevated response read

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes Temp No Well I.D. #:

No Samples Collected

BORING LOG

PROJECT NAME: CWC, Site 27 BORING NUMBER: 27BØ7
PROJECT NUMBER: DATE: 7/8/99
DRILLING COMPANY: Columbia GEOLOGIST:
DRILLING RIG: Strutoprobe DRILLER:

Sample No. and Type or RQD	Depth (Ft.) or Run No	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler Bkz	Borehole**	Drilling Bkz**
X	1					Brn.	Fine Sand		Moist				
X	2												
	3								Saturated				
	4												
	5												

* When rock coring, enter rock brokeness
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read

Drilling Area Background (ppm):

Remarks:

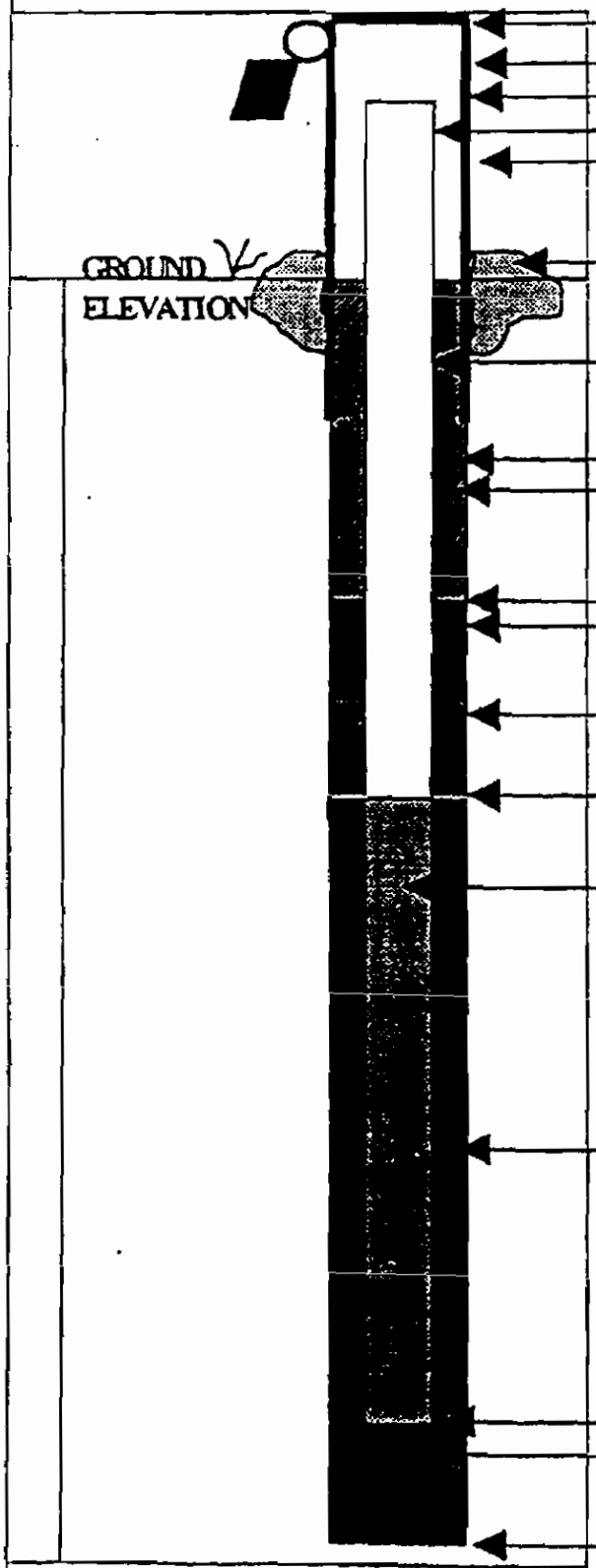
Converted to Well: Yes Temp No Well I.D. #:

Hand Auger

BORING NO : MW01

OVERBURDEN MONITORING WELL SHEET

PROJECT	CKE	LOCATION:	Site 27	DRILLER	R. Brandt
PROJECT NO.		BORING	MW01	METHOD:	DPT
ELEVATION		DATE	8/4/99	DRILLING	
FIELD GEOLOGIST				DEVELOPMENT:	NA



ELEVATION OF TOP OF SURFACE CASING:

ELEVATION OF TOP OF RISER PIPE:

STICK-UP TOP OF SURFACE CASING:

STICK-UP RISER PIPE:

I.D. OF SURFACE CASING:

TYPE OF SURFACE CASING:

TYPE OF SURFACE SEAL: Concrete - Flush

RISER PIPE I.D.:

TYPE OF RISER PIPE: 40 PVC

BOREHOLE DIAMETER:

TYPE OF SEAL:

ELEVATION / DEPTH OF SEAL: 1 0.5'

TYPE OS SEAL: Fine Sand

DEPTH TOP OF SAND PACK: 1.0'

ELEVATION / DEPTH TOP OF SCREEN: 12.0'

TYPE OF SCREEN: PVC-40

SLOT SIZE X LENGTH: 0.01" X 10'

I.D. OF SCREEN: 1.25"

TYPE OF SAND PACK: Medium

ELEVATION / DEPTHBOTTOM OF SCREEN: 112.0'

ELEVATION / DEPTH BOTTOM OF SAND PACK: 112.0

TYPE OF BACKFILL BELOW OBSERVATION WELL:

ELEVATION / DEPTH OF HOLE: 112.0'

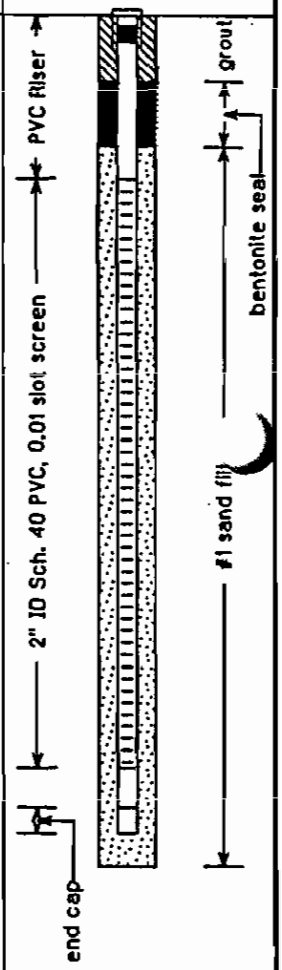
EnSafe/Allen & Hoshall

Monitoring Well NBCE065001

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317543.39 E, 377256.57 N*
Location: *Charleston, SC*	Surface Elevation: *7.1 feet msl*
Started at *1000 on 12-7-95*	TOC Elevation: *6.92 feet msl*
Completed at *1150 on 12-7-95*	Depth to Groundwater: *2.78 feet TOC* Measured: *3/13/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *4.14 feet msl*
Drilling Company: *Atlantic Drilling (SC cert #1210*	Total Well Depth: *12.5 feet bgs*
Geologist: *B. Blythe*	Well Screen: *2.5 to 11.5 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: concrete walk	
							SM GM	Sand: light brown, gravelly, muddy, dry to moist.	3.1 2.8
5			1	60	0		OL	Clay: dark gray–black, high organic content, fat, soft, moist to wet, low plasticity, H_2S odor --Marsh clay.	1.9
							OL	Clay: Marsh clay as above.	.9 1.6
							PT	Peat: dark brown with light brown root material and grass fibers, soft, moist, H_2S odor.	2.8
10			2	85	0				3.9
							PT	Peat: as above with interbedded clay laminae throughout.	
			3	100	0				5.9
15									
20									

WELL DIAGRAM



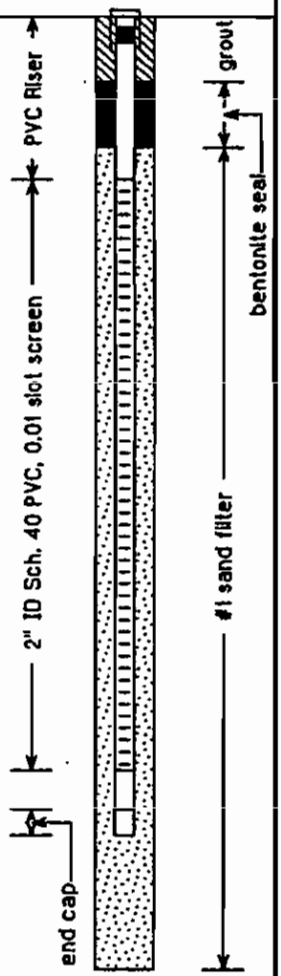
EnSafe/Allen & Hoshall

Monitoring Well NBCE065003

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317469.31 E, 377112.29 N*
Location: *Charleston, SC*	Surface Elevation: *8.3 feet msl*
Started at *1015 on 10-26-95*	TOC Elevation: *8.15 feet msl*
Completed at *1200 on 10-26-95*	Depth to Groundwater: *2.65 feet TOC* Measured: *3/13/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *5.50 feet msl*
Drilling Company: *Atlantic Drilling (SC cert #1210)*	Total Well Depth: *12.5 feet bgs*
Geologist: *T. Kafka*	Well Screen: *2.5 to 11.5 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: concrete lot.	
							CL OL	Clay: black, silty, sandy, with wood fragments, wet, grading into dark gray to black, stiff, silty, low plasticity, wet clay.	3.3
							CL SC	Clay: gray, with increased sand content (very fine to fine), well-sorted, gray.	2.5
			1	55	0				2
							SM SC	Sand: gray, very fine to fine, well-sorted, silty, with some clay pods, saturated.	.3
							OH OL	Clay: dark gray to black with light gray silty laminae, low plasticity, high organic content, wet.	.1
			2	100	0		OH OL		1.2
								Shelby tube (9.7-11.7'): top and bottom--marsh clay as above.	1.4
			3	32					2.2
							OH OL	Clay: marsh clay as above.	4.6
							PT	Peat: brown, with golden to orange wood fibers and grass, silty, high organic content, soft, wet, strong H_2S odor.	5.3
			4	87	0				5.9

WELL DIAGRAM



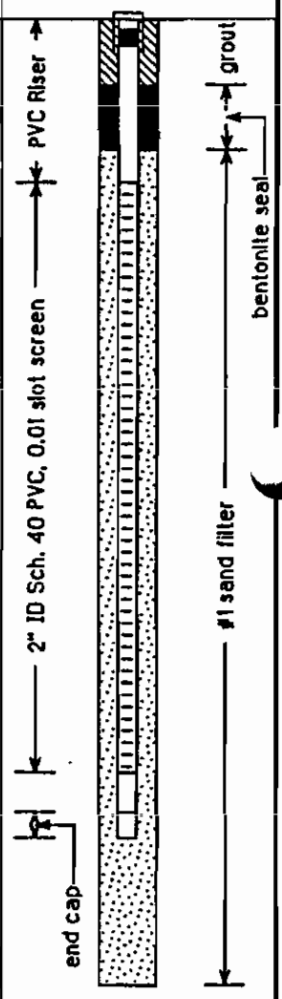
EnSafe/Allen & Hoshall

Monitoring Well NBCE065004

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317441.43 E, 377076.90 N*
Location: *Charleston, SC*	Surface Elevation: *8.3 feet msl*
Started at *1055 on 10-18-95*	TOC Elevation: *8.11 feet msl*
Completed at *1140 on 10-23-95*	Depth to Groundwater: *2.12 feet TOC* Measured: *3/13/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *5.99 feet msl*
Drilling Company: *Atlantic Drilling (SC cert #1210)*	Total Well Depth: *12.5 feet bgs*
Geologist: *T. Kafka*	Well Screen: *2.5 to 11.5 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: concrete pad	
5							OL	Clay: black, silty, low plasticity, soft, wet.	3.3
							SM SC	Sand: light to dark gray, very fine to fine, silty, moderately well sorted, trace clay, wet.	2.8 / 2.4
			1	45	5.8				
							OH OL	Clay: dark gray to black with light gray silty laminae, low plasticity, some wood and grass fibers, soft, wet.	1 / 1.4
10			2	100	11				
							OH OL	Clay: as above with extensive yellow to orange brown wood/grass fibers.	4.1 / 4.9
							PT	Peat: brown to orange brown, extensive wood and grass fibers, silty, wet.	5.8
			3	100	16.6				
15									
20									

WELL DIAGRAM



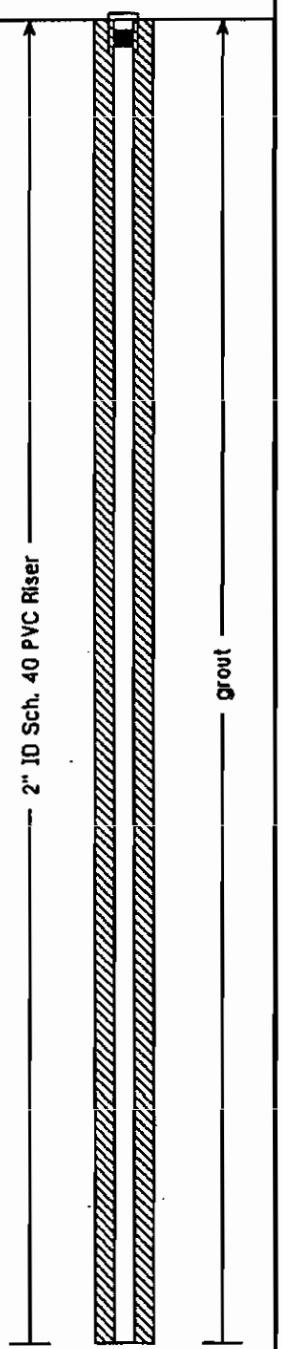
EnSafe/Allen & Hoshall

Monitoring Well NBCE06504D

Project: ZONE E – Naval Base Charleston	Coordinates: 2317421.31 E, 377119.32 N
Location: Charleston, SC	Surface Elevation: 8.5 feet msl
Started at 1030 on 1-19-96	TOC Elevation: 8.41 feet msl
Completed at 1200 on 1-19-96	Depth to Groundwater: 6.97 feet TOC Measured: 3/13/96
Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit)	Groundwater Elevation: 1.44 feet msl
Drilling Company: Alliance Environmental (SC Cert #889)	Total Well Depth: 39.7 feet bgs
Geologist: B. Blythe	Well Screen: 29.8 to 39.2 feet bgs

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							GW GM	Surface conditions: concrete Gravel: light brown, cobbles and silty medium sand, wet.	
							SM SC	Sand: brown, fine to medium, with some silty clay, moist.	6.5
							OL OH	Clay: dark gray, fat, firm, moist.	5.5 5
5			1	70	11.5		OL	Clay: black, fat, moist, marsh clay.	3.5
10							PT	Peat: brown, high organic content.	7
							SW	Sand: gray, fine to medium, no fines, moist.	3.1 5.1
15			2	86	3.4		SW	Sand: as above.	6.5
20									

WELL DIAGRAM



EnSafe/Allen & Hoshall

Monitoring Well NBCE06504D

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317421.31 E, 377119.32 N*
Location: *Charleston, SC*	Surface Elevation: *8.5 feet msl*
Started at *1030 on 1-19-96*	TOC Elevation: *8.41 feet msl*
Completed at *1200 on 1-19-96*	Depth to Groundwater: *6.97 feet TOC* Measured: *3/13/96*
Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)*	Groundwater Elevation: *1.44 feet msl*
Drilling Company: *Alliance Environmental (SC Cert #889)*	Total Well Depth: *39.7 feet bgs*
Geologist: *B. Blythe*	Well Screen: *29.8 to 39.2 feet bgs*

DEPTH IN FEET	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
				SW		
				PT	Peat: yellow to brown.	13.5
						15.4
25	3	89	0	SW	Sand: gray, fine to medium, no fines, moist.	16.5
						20
30				SM/PT	Sand: brown to black, intermixed with peat, firm to stiff, moist.	
						23
				SW/SM	Sand: gray to brown, moist.	
						25
				CH/OH	Clay: gray, fat, stiff, moist--dewatered marsh clay; increase in sand content with depth to sandy clay/clayey sand of medium to high plasticity, firm.	26.5
35	4	100	0	SC	Sand: medium to coarse, clayey.	
						30.3
				SM/GM/CH	Lag deposit: gravelly PO_4 nodules and shell hash, silty, sandy.	30.7
40						

WELL DIAGRAM

2" ID Sch. 40 PVC Riser

0.01 slot PVC screen

end cap

grout

bentonite

#1 sand pack

EnSafe/Allen & Hoshall

Monitoring Well NBCE06504D

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317421.31 E, 377119.32 N*
Location: *Charleston, SC*	Surface Elevation: *8.5 feet msl*
Started at *1030 on 1-19-96*	TOC Elevation: *8.41 feet msl*
Completed at *1200 on 1-19-96*	Depth to Groundwater: *6.97 feet TOC* Measured: *3/13/96*
Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)*	Groundwater Elevation: *1.44 feet msl*
Drilling Company: *Alliance Environmental (SC Cert #889)*	Total Well Depth: *39.7 feet bgs*
Geologist: *B. Blythe*	Well Screen: *29.8 to 39.2 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)	WELL DIAGRAM
45			5	100	0		CH	Clay: gray, fat, firm to stiff, with fine sand and shell hash laminae interspersed throughout--dewatered marsh clay.		hole plug
								Shelby tube 45-47.5': dewatered marsh clay as above.		
			6	100					-39	
50										
55										
60										

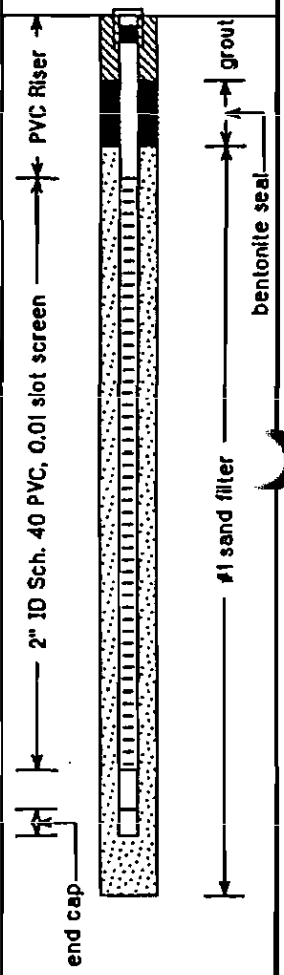
EnSafe/Allen & Hoshall

Monitoring Well NBCE065005

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317412.39 E, 377162.28 N*
Location: *Charleston, SC*	Surface Elevation: *8.5 feet msl*
Started at *1300 on 10-26-95*	TOC Elevation: *8.22 feet msl*
Completed at *1500 on 10-26-95*	Depth to Groundwater: *5.48 feet TOC* Measured: *3/13/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *2.74 feet msl*
Drilling Company: *Atlantic Drilling (SC cert #1210)*	Total Well Depth: *12.5 feet bgs*
Geologist: *T. Kafka*	Well Screen: *2.5 to 11.5 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: concrete alleyway.	
							SM SC	Sand: dark gray to gray, very fine to fine, moderately well-sorted, silty, some clayey pods, wet.	3.5 – 3.1
5							OL OH	Clay: dark gray to black, silty, moderately plastic, soft, wet.	3.1 – 2.3
			1	60	0				
							OL OH	Clay: dark gray to dark brown, with wood fibers and grass, silty, moderately plastic, wet.	5 – 8
			2	100	0		PT	Peat: dark brown, soft, silty, with grass and wood fibers, wet.	8 – 11
10									
							SP SM	Sand: light gray, very fine to fine, well-sorted, silty, with grass and wood fibers, saturated; clayey lens at 11.3'.	2.5 – 4
			3	100	0				
15									
20									

WELL DIAGRAM



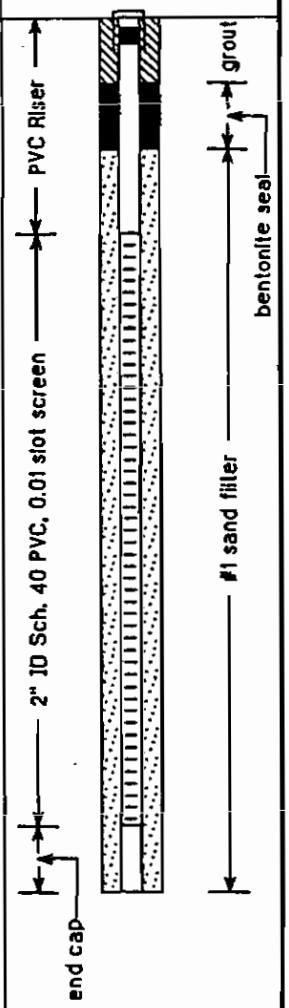
EnSafe/Allen & Hoshall

Monitoring Well NBCE065007

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317497.72 E, 377055.81 N*
Location: *Charleston, SC*	Surface Elevation: *8.6 feet msl*
Started at *0900 on 9-11-96*	TOC Elevation: *8.31 feet msl*
Completed at *1030 on 9-11-96*	Depth to Groundwater: *2.83 feet TOC* Measured: *10/16/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *5.48 feet msl*
Drilling Company: *Atlantic Drilling (S.C.# 1210)*	Total Well Depth: *13.3 feet bgs*
Geologist: *J. Cooey*	Well Screen: *3.3 to 12.3 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt.	
								PID reading of 150 ppm in cuttings from 2.0 to 4.0 ft.	
									4.6
5			1	100			SP	Sand: gray; fine to very fine, shell hash throughout.	
									3.1
									.6
							SP	Sand: gray; very fine.	
									.4
							ML	Silt: black; clayey.	
10			2	100					1.4
								PID reading spike of 1710 ppm in cuttings from 10.0 to 13.0 ft.	
									4.4
							SP	Sand: lt.gray; very fine to fine; w/shell fragments.	
									5.4
							CL	Clay: dark gray-black; silty.	
15			3	100					6.4
20									

WELL DIAGRAM



APPENDIX C

FIELD SAMPLING DATA SHEETS

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page ___ of ___

Project Site Name: CNC zone E/ site 27
Project No.: N0126

Sample ID No.: 27SLB0701
Sample Location: CNCB07
Sampled By: P. Calligan
C.O.C. No.:

- [ ] Surface Soil
- [x] Subsurface Soil
- [ ] Sediment
- [ ] Other:
- [ ] QA Sample Type:

Type of Sample:
- [x] Low Concentration
- [ ] High Concentration

GRAB SAMPLE DATA:

Date: 10/12/99 Time: 1700 Method: Hand Auger Monitor Reading (ppm):	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	1' to 2'	Light Brown	silty sand, moist

COMPOSITE SAMPLE DATA:

Date: Method: Monitor Readings (Range in ppm):	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
8260 VOAs	4 - Encores		
8270 PAHs	1 - 4oz. Jar		
Metals	1 - 2oz. Jar		
TPH	1 - 8oz. Jar		
TOC	1 - 4oz. Jar		
FOC	From other Jars		
Grain Size	1 - 32oz. Jar		

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Paul E. Calligan

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: site 27 **Project No.:** 0126

Location: CNC 27 **Personnel:** Jeff Alexander / Jennifer Elliott

Weather Conditions: breezy, cool, very nice. **Measuring Device:**

Tidally Influenced: Yes ___ No ___ **Remarks:**

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Readin (feet)*	Thickness of Free Produc (feet)*	Groundwater Elevation (feet)*	Comments
MP1	9/23	8.54		11.68	1.94			
NBCE-065-007 ~~X07~~	9/23	8:55		13.16	3.32			
NBCE-065-003 ~~X03~~	9/23	857		12.43	2.24			
NBCE-065-004 ~~X04~~	9/23	859		12.41	2.33			
NBCE-065-04D ~~X4D~~	9/23	901		39.62	5.54			
NBCE-065-005 ~~X05~~	9/23	905		12.40	3.22			

* All measurements to the nearest 0.01 foot

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Zone E Site 27
Project No.: N0126

[] Domestic Well Data
[*] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 27GLMØ1Ø1
Sample Location: ENC27MØ1
Sampled By: JA/JE
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-23-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1645-1050	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	clear	7.19	0.304	26.1	-10	1.34	—	—

PURGE DATA:

Date: 9-23-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.63	0.360	25.4	103	0.84	—	—
Monitor Reading (ppm): —	1	7.07	0.307	25.9	-10	1.03	—	—
Well Casing Diameter & Material	2	7.14	0.304	26.0	-10	0.97	—	—
Type: 1.25" PVC	3	7.19	0.304	26.1	-10	1.34	—	—
Total Well Depth (TD): 11.68								
Static Water Level (WL): 1.99								
One Casing Volume(gal/L): .6								
Start Purge (hrs): 0933								
End Purge (hrs): 1001								
Total Purge Time (min): 28 min								
Total Vol. Purged (gal/L): ~2.5 gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
8260	HCl	3 x 40 ml	yes
PAH	—	2 x 1 L	↓
Metals	HNO_3	1 x	
Dissolved Methane	HCl	3 x 40 ml	
Anions	—	1 x	↓

OBSERVATIONS / NOTES:

9.67

Circle if Applicable:
MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Zone E Site 27
Project No.: NO126

Sample ID No.: 27GLX0501
Sample Location: NBCE-0605-005
Sampled By:
C.O.C. No.:

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-23-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1100	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow								

PURGE DATA:

Date: 9-23-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.17	.583	25.5	0	0.25	—	ORP —
Monitor Reading (ppm):	1	6.31	.586	26.2	0	1.29	—	1.47
Well Casing Diameter & Material	2	6.55	.626	26.0	63	2.68	—	2.94
Type: 2" PVC	3	6.57	.610	25.7	12	2.46	—	4.41
Total Well Depth (TD): 12.40								
Static Water Level (WL): 3.22								
One Casing Volume(gal/L): 1.47								
Start Purge (hrs): 0922								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
8260	HCl	3 x 40 ml	
PAH	—	2 x 1 L	
Metals	HNO_3	1 x	
Dissolved Methane	HCl	3 x 40 ml	
Anions	—	1 x	

OBSERVATIONS / NOTES:

0938: Well purged dry and pump turned off
0943: Well pump restarted
0948: Well purged dry and pumped turned off.

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Zone E Site-27
Project No.: NO126

Sample ID No.: 27GLX0401
Sample Location:
Sampled By:
C.O.C. No.:

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-23-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1010	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	clear	7.17	0.553	27.2	12	1.99	—	—

PURGE DATA:

Date: 9-23-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.96	0.529	27.1	20	1.21	—	—
Monitor Reading (ppm):	1	7.15	0.541	26.7	24	2.08	—	1.61
Well Casing Diameter & Material	2	7.20	0.548	27.0	19	1.74	—	3.22
Type: 2" PVC	3	7.17	0.553	27.2	12	1.99	—	4.83
Total Well Depth (TD): 12.41								
Static Water Level (WL): 2.33								
One Casing Volume(gal/L): 1.61								
Start Purge (hrs): 0918								
End Purge (hrs): 0958								
Total Purge Time (min): 40								
Total Vol. Purged (gal/L): 4.83								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
8260	HCl		✓
PAH	—		✓
Metals	HNO_3		✓

OBSERVATIONS / NOTES:

Circle if Applicable:
MS/MSD
Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Zone E Site 27
Project No.: ND126

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 27GLX4D01
Sample Location: NBCE-065-04D
Sampled By:
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-23-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1012	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	Clear	6.74	1.48	23.2	14	1.58	—	—

PURGE DATA:

Date: 9-23-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.67	1.38	23.2	27	1.73	—	—
Monitor Reading (ppm):	1	6.73	1.42	23.1	23	1.54	—	1.6
Well Casing Diameter & Material	2	6.82	1.46	23.2	28	2.36	—	3.2
Type: 2" PVC	3	6.74	1.48	23.2	14	1.58	—	4.8
Total Well Depth (TD): 39.62								
Static Water Level (WL): 5.54								
One Casing Volume(gal/L): 1.6								
Start Purge (hrs): 0920								
End Purge (hrs): 0952								
Total Purge Time (min): 32								
Total Vol. Purged (gal/L): 4.8								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
8260	HCl		✓
PAH	—		✓
Metals	HNO_3		✓

OBSERVATIONS / NOTES:

* Purging using screen volumes assuming 10 ft. screen.

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Zone E Site 27
Project No.: N0126

Sample ID No.: 27GLX0701
Sample Location: NBCE-0165-0007
Sampled By:
C.O.C. No.:

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 9-23-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1126	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Low Flow	Clear	6.93	.761	28.2	11	1.53	—	—

PURGE DATA:

Date: 9-23-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Low Flow	Initial	6.17	.855	26.3	8	1.32	—	
Monitor Reading (ppm):	1	6.76	.770	28.1	10	1.27	—	
Well Casing Diameter & Material	2	6.85	.778	28.0	9	1.01	—	
Type: 2" PVC	3	6.93	.761	28.2	11	1.53	—	
Total Well Depth (TD): 13.16								
Static Water Level (WL): 3.32								
One Casing Volume(gal/L): 1.57								
Start Purge (hrs): 1015								
End Purge (hrs): 1050								
Total Purge Time (min): :35								
Total Vol. Purged (gal/L): 4								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
8260	HCl	3 x 40ml	
PAH	—	2 x 1 Ltr.	
Metals	HNO_3	1 x 1 Ltr.	
Dissolved Metals	HCl	3 x 40 ml	
Anions	—	1 x .5 ltr.	

OBSERVATIONS / NOTES:

13.16
3.32
9.84

.5 Z
9.84
16
5904
9840
15744

Circle if Applicable:

MS/MSD | Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Zone E Site 27
Project No.: N0126

[] Domestic Well Data
[X] Monitoring Well Data
[] Other Well Type:
[] QA Sample Type:

Sample ID No.: 27GLX030I
Sample Location: NBCE-000500
Sampled By: JA/JE
C.O.C. No.:
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: 4-23-99	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time: 1010	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Method: Peristaltic	clear brownish	8.94	0.671	27.3	≈10	0.52	—	—

PURGE DATA:

Date: 9-23-99	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
Method: Peristaltic	Initial	8.68	0.611	27.2	6	0.27	—	—
Monitor Reading (ppm): —	1	8.75	0.565	27.1	2	1.10	—	—
Well Casing Diameter & Material	2	8.83	0.581	27.2	3	0.93	—	—
Type: 2" PVC	3	8.91	0.615	27.1	5	0.56	—	—
Total Well Depth (TD): 12.43	4	8.94	0.671	27.3	10	0.52	—	—
Static Water Level (WL): 2.24								
One Casing Volume(gal/L): 1.6 gal (Screen)								
Start Purge (hrs): 0924								
End Purge (hrs): 0957								
Total Purge Time (min): 33 min								
Total Vol. Purged (gal/L): ~6 gal								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	HCl/4°C	(3) 40 mL vials	yes
PAH	4°C	(2) 1 L Amber	↓
Metals	HNO_3/4°C	(1) 1 L Plastic	↓

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: Zone E Site 27 | Sample ID No.: 27GLM0101
Project No.: N0126 | Sample Location: MW 01
Sampled By: TNT & JJM | Duplicate: ☐
Field Analyst: JJM & JA | Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JJM

SAMPLING DATA:

Date: 9-23-99	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Time: 1050	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Method: Low Flow	Clear	—	0.304	26.1	~10	1.34	—	7.19

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 1108

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 0.4 mg/L

Notes:

Alkalinity:

Analysis Time: 1034

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☑	100-400 mg/L	100 ml	1.600 N	1.0	0 & 241	x 1.0 =	241 mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0 =	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	241

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 1102

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☑	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
_____	x 0.2 =	mg/L
_____	x 1.0 =	mg/L
106	x 2.0 =	212 mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: Site 27 | Sample ID No.: 27GLMW01

Project No.: 0126 | Sample Location: (NC27MW-1

Sampled By: JA/JE/JM/JE | Duplicate: ☐

Field Analyst: JA/JM | Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): JA

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-8~~9~~10 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1031

Program/Module: 610nm 93 Other: _____

Concentration: 0.02 mg/L Filtered: ☐

Notes:

Sulfate (SO_4^{2-}):

Equipment: ~~DR-700~~ DR-8__ Other: _____ Analysis Time: _____

Program/Module: ~~91~~

Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrite (NO_2^--N): Analysis Time: 1130

Equipment: DR-700 DR-8~~9~~10 Other: _____ Filtered: ☐

Program/Module: 60

Concentration: 0.081 mg/L Reagent Blank Correction: ☐

Standard Solution: ☐ Results: ☐

Notes:

Nitrate (NO_3^--N): Analysis Time: _____

Equipment: DR-700 DR-8__ Other: _____ Filtered: ☐

Program/Module: 55

Concentration: _____ mg/L

Nitrite Interference Treatment: ☐

Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: ~~DB~~ Site 27 | Sample ID No.: 27GL MØ141
Project No.: Ø126 | Sample Location: 27 MW 1
Sampled By: JA/JE/JM/TT | Duplicate: ☐
Field Analyst: JA/JM | Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JA

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-890 HACH MN-5 Other: _____ Analysis Time: 1146
Program/Module: 525nm 41
Concentration: 6.1 mg/L Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-890 IR-18C Color Wheel Other: _____ Analysis Time: 1446
Program/Module: 500nm 33
Concentration: Ø.Ø3 mg/L Filtered: ☐
Notes:

Hydrogen Sulfide (H_2S):

Equipment: (HS-C) Other: _____ Analysis Time: 1149
Concentration: 0 mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Mulitplication is correct for each *Multiplier* table: ☑
Final calulated concentration is within the appropriate *Range Used* block: ☑
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☑
Title block is initialized by person who performed the QA/QC Ckecklist: ☑

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: CNC site 27 zone E
Sample ID No.: 27GLX0501
Project No.: N0126
Sample Location: MWx65
Sampled By: TNT & JJM
Duplicate: ☐
Field Analyst: JJM & JA
Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JJM

SAMPLING DATA:

Date: 9-23-99	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Time: 1100	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Method: Low Flow	clear	—	0.610	25.7	12	2.46	—	6.67

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 1-12 mg/L)) Analysis Time: 1123

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 3.0 mg/L

Notes:

Alkalinity:

Analysis Time: 1050

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☑	100-400 mg/L	100 ml	1.600 N	1.0	0 & 203	x 1.0 =	203 mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0 =	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	203

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 1147

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☑	100-400 mg/L	200 ml	3.636 N	1.0
☐	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
_____	x 0.2 =	mg/L
203	x 1.0 =	203 mg/L
_____	x 2.0 =	mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Project Site Name: Site 27 | Sample ID No.: 279LX0501
Project No.: 0126 | Sample Location: NBCE-065-0005
Sampled By: JA/JE/JM/TT | Duplicate: ☐
Field Analyst: JA/JM | Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JA

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-890 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1032
Program/Module: 610nm 93 Other: _____

Concentration: 0.02 mg/L Filtered: ☐

Notes:

Sulfate (SO_4^{2-}):

Equipment: DR-700 DR-8__ Other: _____ Analysis Time: _____
Program/Module: 91
Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Nitrite (NO_2^--N):

Analysis Time: 1131
Equipment: DR-700 DR-810 Other: _____ Filtered: ☐
Program/Module: 60
Concentration: 0.042 mg/L Reagent Blank Correction: ☐
Standard Solution: ☐ Results: ☐

Notes:

Nitrate (NO_3^--N):

Analysis Time: _____
Equipment: DR-700 DR-8__ Other: _____ Filtered: ☐
Program/Module: 55
Concentration: _____ mg/L
Nitrite Interference Treatment: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____

Notes:

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Project Site Name: Site 22 | Sample ID No.: 27GLX0501
Project No.: 0126 | Sample Location: NBEG065 0045
Sampled By: JA/JM/JE/ET | Duplicate: ☐
Field Analyst: JA/JM | Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): JA

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-890 HACH MN-5 Other: _____ Analysis Time: 1107
Program/Module: 525nm 41
Concentration: 0.5 mg/L Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-890 IR-18C Color Wheel Other: _____ Analysis Time: 1047
Program/Module: 500nm 33
Concentration: 3.30 mg/L Filtered: ☐
Notes: LIMIT

Hydrogen Sulfide (H_2S):

Equipment: (HS-C) Other: _____ Analysis Time: 1115
Concentration: 0 mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Mulitplication is correct for each *Multiplier* table: ☑
Final calulated concentration is within the appropriate *Range Used* block: ☑
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☑
Title block is initialized by person who performed the QA/QC Ckecklist: ☑

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: Zone E Site 27 | Sample ID No.: 276LX0701
Project No.: N0126 | Sample Location: MWX07
Sampled By: TNT & JJM | Duplicate: ☐
Field Analyst: JJM & JA | Blank: ☐
Field Form Checked as per QA/QC Checklist (initials): [illegible]

SAMPLING DATA:

Date: 9-23-99	Color (Visual)	ORP (Eh) (+/- mv)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (Meter, mg/l)	Sal. (%)	pH (SU)
Time: 1126								
Method: Low Flow	Clear	—	0.761	28.2	11	1.53	—	6.93

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT (CHEMetrics (Range: 0-1 mg/L)) Analysis Time: 1113

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
_____	x 0.01 =	mg/L
_____	x 0.02 =	mg/L

CHEMetrics: 1.0 mg/L

Notes:

Alkalinity:

Equipment: (HACH Digital Titrator AL-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 1045 Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & _____	x 0.1 =	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4 =	mg/L
☑	100-400 mg/L	100 ml	1.600 N	1.0	0 & 343	x 1.0 =	343 mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0 =	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0 =	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0 =	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	0	0	343

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

Carbon Dioxide:

Equipment: (HACH Digital Titrator CA-DT) CHEMetrics (Range: _____mg/L) Analysis Time: 1140

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☑	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count		Concentration
_____	x 0.1 =	mg/L
_____	x 0.2 =	mg/L
_____	x 1.0 =	mg/L
115	x 2.0 =	230 mg/L

CHEMetrics: _____mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:_____ Digits Required: 1st.:_____ 2nd.:_____ 3rd.:_____

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: Sit 27
Project No.: 0126
Sampled By: JA/JE/JM/TT
Field Analyst: JA/JM
Field Form Checked as per QA/QC Checklist (initials): JA

Sample ID No.: 27GLX07Ø1
Sample Location: NBCE-ØCS-Ø07
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-890 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1636
Program/Module: 610nm 93 Other: _____

Concentration: Ø.Ø2 mg/L Filtered: ☐
Notes:

Sulfate (SO_4^{2-}):

Equipment: DR-700 DR-8__ Other: _____ Analysis Time: _____
Program/Module: 91
Concentration: _____ mg/L Filtered: ☐

Standard Solution: ☐ Results: _____
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Nitrite (NO_2^--N):

Analysis Time: 1129
Equipment: DR-700 DR-890 Other: _____ Filtered: ☐
Program/Module: 60
Concentration: Ø.Ø44 mg/L Reagent Blank Correction: ☐
Standard Solution: ☐ Results: ☐
Notes:

Nitrate (NO_3^--N):

Analysis Time: _____
Equipment: DR-700 DR-8__ Other: _____ Filtered: ☐
Program/Module: 55
Concentration: _____ mg/L
Nitrite Interference Treatment: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Project Site Name: Site 27
Project No.: 0126
Sampled By: JA/JE/JM/TT
Field Analyst: JA/JM
Field Form Checked as per QA/QC Checklist (initials): ~~X~~

Sample ID No.: 27GL X07D1
Sample Location: NBCE-065-007
Duplicate: ☐
Blank: ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-890 HACH MN-5 Other: _____ Analysis Time: 1105
Program/Module: 525nm 41
Concentration: 0.0 mg/L
Filtered: ☐
Digestion: ☐
Standard Solution: ☐ Results: _____ Reagent Blank Correction: ☐
Standard Additions: ☐ Digits Required: 0.1ml:_____ 0.2ml:_____ 0.3ml:_____
Notes:

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-890 IR-18C Color Wheel Other: _____ Analysis Time: 1045
Program/Module: 500nm 33
Concentration: 1.70 mg/L
Filtered: ☐
Notes:

Hydrogen Sulfide (H_2S):

Equipment: HS-C Other: _____ Analysis Time: 1028
Concentration: 0 mg/L Exceeded 5.0 mg/L range on color chart: ☐
Notes:

QA/QC Checklist:

All data fields have been completed as necessary: ☑
Correct measurement units are cited in the SAMPLING DATA block: ☑
Mulitplication is correct for each *Multiplier* table: ☑
Final calulated concentration is within the appropriate *Range Used* block: ☑
Alkalinity *Relationship* is determined appropriatly as per manufacturer instructions: ☑
QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☑
Nitrite Interference treatment used for Nitrate test if Nitrite was detected: ☑
Title block is initialized by person who performed the QA/QC Ckecklist: ☑

APPENDIX D

SOIL AND GROUNDWATER LABORATORY ANALYTICAL DATA

S.W.COLE ENGINEERING, INC.

RR 3, Box 7230, China Road, Winslow, ME 04901 TEL (207) 873-4283 FAX (207) 873-4977
Six Liberty Drive, Bangor, ME 04401 TEL (207) 848-5714 FAX (207) 848-2413
Gray Plaza, P. O. Box 378, Gray, ME 04039 TEL (207) 657-2866 FAX (207) 657-2910
91 Water St., P. O. Box 220, Caribou, ME 04736 TEL (207) 496-1511 FAX (207) 496-1501
33 Londonderry Rd., #b, Londonderry, NH 03053 TEL (603) 437-9600 FAX (603) 437-9655

LAB REPORT

October 21, 1999
99-812 M

Katahdin Analytical Services
ATTN: Andrea Colby
P.O. Box 720
Westbrook, Maine 04092

Reference: Laboratory Testing

SWC Sample No.	Material Source	Date Received	Date Tested
S-38	WP 4285-1	10-14-99	10-20-99
S-39	*WP 4272-2 (2754B0701)	10-14-99	10-20-99

*(WP 4272-2 is the "Lab Number" on Katahdin's analytical report for sample 2754B0701)

TEST RESULTS

Grain Size Analysis (Hydrometer)

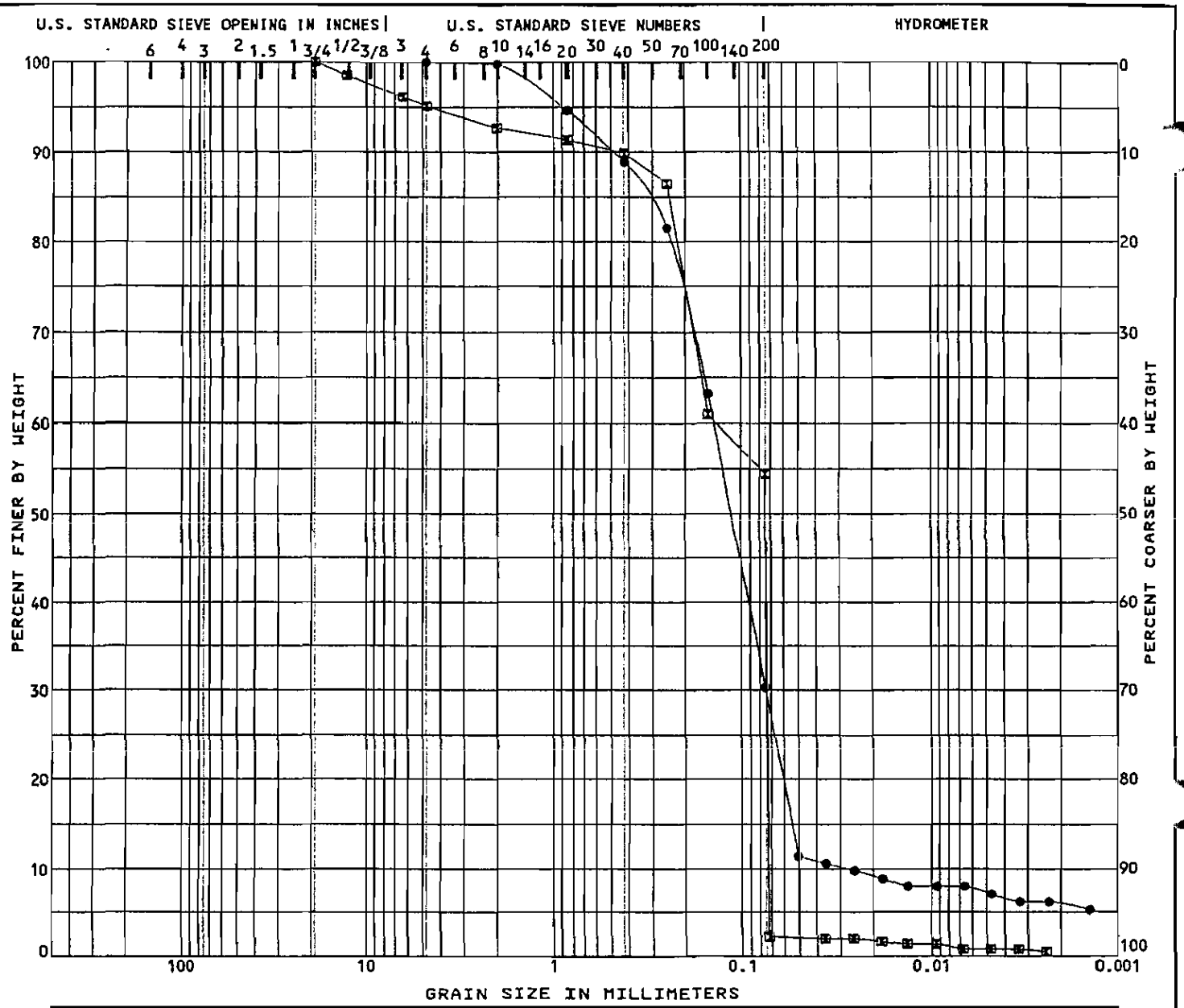
The samples were tested in accordance with ASTM D-422, "Particle Size Analysis of Soils". After soaking for at least 16 hours, stirring apparatus A (a blender) was used to stir the samples for one minute.

	Percent of Material			
Sample Number	Gravel, 3" to No. 4	Sand No. 4 to No. 200	Silt 0.074 to 0.005mm	Clay Smaller Than 0.005 mm
S-38	0.0	69.7	23.0	7.3
(2754B0701) S-39	4.9	40.7	53.6	0.8

Robert E. Chaput, Jr., P.E.
Geotechnical Engineer

REC:rac
Checked By:

P:\SWC-99\99-812\99-812dtr.doc



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	WC%	LL	PL	PI	Cc	Cu
●	S-38 WP 4285-1							
⊠	S-39 WP 4272-2							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	S-38 WP 4285-1	4.75	0.14	0.075	0.0275	0.0	69.7	23.0	7.3
⊠	S-39 WP 4272-2	19.00	0.14	0.074	0.0728	4.9	40.7	53.6	0.8

S.W.COLE
ENGINEERING, INC.

Project Katahdin Analytical Services
Location Westbrook, Maine
SWC Job No. 99-812
Sheet No. 1
Date October 21, 1999

GRADATION CURVES

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308
Proj. ID: CNC CHARLESTON

Lab Number: WP4272-2
SDG: WP4272
Report Date: 11/3/99
PO No.: N7912-P98264
Project: CTO #68
% Solids: 90
Method: SW8260
Date Analyzed: 10/14/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27SLB0701	SL	10/12/99	10/13/99	10/14/99	KMC	5030	KMC

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<4	ug/Kg	0.88	4	5
TOLUENE	<4	ug/Kg	0.88	4	5
1,2-DIBROMOETHANE	<4	ug/Kg	0.88	4	5
ETHYLBENZENE	<4	ug/Kg	0.88	4	5
NAPHTHALENE	<4	ug/Kg	0.88	4	5
MTBE	<4	ug/Kg	0.88	4	5
TOTAL XYLENES	<4	ug/Kg	0.88	4	5
DIBROMOFLUOROMETHANE	118	%	0.88		
1,2-DICHLOROETHANE-D4	118	%	0.88		
TOLUENE-D8	107	%	0.88		
P-BROMOFLUOROBENZENE	86	%	0.88		

Report Notes:

RATHBUN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan.
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4272-2
SDG: WP4272
Report Date: 11/2/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: 90
Method: EPA 8270
Date Analyzed: 10/18/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27SLB0701	SL	10/12/99	10/13/99	10/15/99	LAP	EPA 3550	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<360	ug/Kg	1.1	360	330
2-METHYLNAPHTHALENE	<360	ug/Kg	1.1	360	330
ACENAPHTHYLENE	<360	ug/Kg	1.1	360	330
ACENAPHTHENE	<360	ug/Kg	1.1	360	330
FLUORENE	<360	ug/Kg	1.1	360	330
PHENANTHRENE	<360	ug/Kg	1.1	360	330
ANTHRACENE	<360	ug/Kg	1.1	360	330
FLUORANTHENE	<360	ug/Kg	1.1	360	330
PYRENE	<360	ug/Kg	1.1	360	330
BENZO[A]ANTHRACENE	<360	ug/Kg	1.1	360	330
CHRYSENE	<360	ug/Kg	1.1	360	330
BENZO[B]FLUORANTHENE	<360	ug/Kg	1.1	360	330
BENZO[K]FLUORANTHENE	<360	ug/Kg	1.1	360	330
BENZO[A]PYRENE	<360	ug/Kg	1.1	360	330
INDENO[1,2,3-CD]PYRENE	<360	ug/Kg	1.1	360	330
DIBENZ[A,H]ANTHRACENE	<360	ug/Kg	1.1	360	330
BENZO[G,H,I]PERYLENE	<360	ug/Kg	1.1	360	330
NITROBENZENE-D5	30	%	1.1		
2-FLUOROBIPHENYL	53	%	1.1		
TERPHENYL-D14	67	%	1.1		

Report Notes:

1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** 27SLB0701

Matrix: SOIL **SDG Name:** WP4272

Percent Solids: 89.6 **Lab Sample ID:** WP4272-002

Concentration Units (ug/L or mg/Kg dry weight): mg/Kg

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	5000			P	1
7440-36-0	ANTIMONY	0.81			P	1
7440-38-2	ARSENIC	2.8			P	1
7440-39-3	BARIUM	24.2			P	1
7440-41-7	BERYLLIUM	0.22	B		P	1
7440-43-9	CADMIUM	0.98			P	1
7440-70-2	CALCIUM	16300			P	1
7440-47-3	CHROMIUM	32.2			P	1
7440-48-4	COBALT	3.5			P	1
7440-50-8	COPPER	103			P	1
7439-89-6	IRON	5120			P	1
7439-92-1	LEAD	109			P	1
7439-95-4	MAGNESIUM	658			P	1
7439-96-5	MANGANESE	47.2			P	1
7439-97-6	MERCURY	0.08			CV	1
7440-02-0	NICKEL	15.3			P	1
7440-09-7	POTASSIUM	255			P	1
7782-49-2	SELENIUM	0.24	U		P	1
7440-22-4	SILVER	0.18	B		P	1
7440-23-5	SODIUM	92.0			P	1
7440-28-0	THALLIUM	0.42	U		P	1
7440-62-2	VANADIUM	8.8			P	1
7440-66-6	ZINC	376			P	1

Comments:

Client: Katahdin Analytical
340 County Road
Westbrook, Maine 04092
Contact: Ms. Andrea Colby
Project Description: Former Naval Complex

cc: KATA00199 Report Date: November 03, 1999

Sample ID	: 27SLB0701
Lab ID	: 9910461-02
Matrix	: Soil
Date Collected	: 10/12/99
Date Received	: 10/13/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
General Chemistry											
Total Rec. Petro. Hydrocarbons		353	114	228	mg/kg	1.0	AAT	10/15/99	1030	160780	1
Evaporative Loss @ 105 C		12.0	1.00	1.00	wt%	1.0	GJ	10/15/99	1600	160831	2
Total Organic Carbon		1750	43.1	100	mg/kg	1.0	JB1	11/03/99	1221	161989	3

M = Method	Method-Description
M 1	SW846 9071A
M 2	EPA 3550
M 3	SW846 9060 Modified

Notes:
The qualifiers in this report are defined as follows:
ND indicates that the analyte was not detected at a concentration greater than the detection limit.
J indicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
U indicates that the analyte was not detected at a concentration greater than the detection limit.
* Indicates that a quality control analyte recovery is outside of specified acceptance criteria.

Data reported in mass/mass units is reported as 'dry weight'.

Katahdin
ANALYTICAL SERVICES

CLIENT: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr., Suite 102
Tallahassee, FL 32308

Lab Number : WP-4272-2
Report Date: 11/10/99
PO No. : N7912-P99264
Project : CTO #68

WIC#: CNC CHARLESTON REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
27SLB0701	Solid	P.CALLIGAN	10/12/99	10/13/99

PARAMETER	RESULT	UNITS	DF	*PQL	METHOD	ANALYZED	BY	NOTES
Solids-Total Residue (TS)	90.	wt %	1.0	0.10	CLP/CLP SOW	10/21/99	JF	1
Total Combustible Organics	2.3	wt %	1.0	0.1	ASTM D2974-8	10/21/99	JF	1

* PQL (Practical Quantitation Level) represents laboratory reporting limits and may not reflect sample-specific reporting limits. Sample-specific limits are indicated by results annotated with '<' values.
(1) Sample Preparation on 10/20/99 by JF

11/10/99

LJO/baeajc(dw)/mgm

CC: MS LEE LECK
TETRA TECH NUS
FOSTER PLAZA 7
661 ANDERSEN DR.

CLIENT: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr., Suite 102
Tallahassee, FL 32308

Lab Number : WP-4272-1
Report Date: 11/01/99
PO No. : N7912-P99264
Project : CTO #68

PRELIMINARY
WIC#: CNC CHARLESTON REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
30SLB170708	Solid	P.CALLIGAN	10/12/99	10/13/99

PARAMETER	RESULT	UNITS	DF	*PQL	METHOD	ANALYZED	BY	NOTES
Solids-Total Residue (TS)	92.	wt %	1.0	0.10	CLP/CIP SOW	10/18/99	JF	1

* PQL (Practical Quantitation Level) represents laboratory reporting limits and may not reflect sample-specific reporting limits. Sample-specific limits are indicated by results annotated with '<' values.
(1) Sample Preparation on 10/15/99 by JF

11/01/99

LJO/__ajc(dw)/mem

CC: MS LEE LECK
TETRA TECH NUS
FOSTER PLAZA 7
661 ANDERSEN DR.

WP4272

Katahdin

CHAIN OF CUSTODY RECORD

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, South Carolina 29407
P.O. Box 30712
Charleston, South Carolina 29417
(843) 556-8171

Page 1 of 1

Client Name/Facility Name: Tetra Tech NUS/Charleston Naval Base

Collected by/Company: P. Calligan/Tetra Tech

SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	~~TOC~~ FOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	METALS - specify	Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type	PAHs	Grain Size	Remarks
30SLB170708	10.12.99	1500		X			5						X										X		4 Encores (8260) 1 - 4oz Jar (8270)
27SLB0701	10.12.99	1700		X			7		X				X	X									X	X	4 Encores (8260), 1-12oz. (Metals) 1-4oz (8270), 1-32oz. (Grain Size)

Use F or P in the boxes to indicate whether sample was filtered and/or preserved

SAMPLE ANALYSIS REQUIRED (x) - use remarks area to specify specific compounds or methods

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received by:
Paul E. Calligan	10.12.99	19:10	Fed Ex Airbill # 814755143856		10.13.99	0845	Shelley Williams
Relinquished by:	Date:	Time:	Received by lab by:	Date:	Time:	Remarks:	

White = sample collector Yellow = file Pink = with report

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-15
SDG: WP4075
Report Date: 10/15/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLM0101	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	<5	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	104	%	1.0		
1,2-DICHLOROETHANE-D4	103	%	1.0		
TOLUENE-D8	102	%	1.0		
P-BROMOFLUOROBENZENE	100	%	1.0		

Report Notes:

0000037

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308
Proj. ID: CNC CHARLESTON

Lab Number: WP4075-7
SDG: WP4075
Report Date: 10/9/99
PO No.: N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/5/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLM0101	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<11	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	<11	ug/L	1.1	11	10
FLUORENE	<11	ug/L	1.1	11	10
PHENANTHRENE	<11	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	79	%	1.1		
2-FLUOROBIPHENYL	82	%	1.1		
TERPHENYL-D14	88	%	1.1		

Report Notes: A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** 27GLM0101

Matrix: WATER **SDG Name:** WP4075

Percent Solids: 0.00 **Lab Sample ID:** WP4075-015

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	1190			P	1
7440-36-0	ANTIMONY	7.3	B		P	1
7440-38-2	ARSENIC	12.6			P	1
7440-39-3	BARIUM	55.1			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	2.1	B		P	1
7440-70-2	CALCIUM	58200			P	1
7440-47-3	CHROMIUM	11.4	B		P	1
7440-48-4	COBALT	7.1	B		P	1
7440-50-8	COPPER	141			P	1
7439-89-6	IRON	5340			P	1
7439-92-1	LEAD	42.5			P	1
7439-95-4	MAGNESIUM	1730			P	1
7439-96-5	MANGANESE	118			P	1
7439-97-6	MERCURY	0.09	B		CV	1
7440-02-0	NICKEL	13.21	U		P	1
7440-09-7	POTASSIUM	2420			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	7630			P	1
7440-28-0	THALLIUM	4.49	U		P	1
7440-62-2	VANADIUM	3.7	B		P	1
7440-66-6	ZINC	173			P	1

Comments:

Katahdin
ANALYTICAL SERVICES

CLIENT: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr., Suite 102
Tallahassee, FL 32308

Lab Number : WP-4075-7
Report Date: 10/27/99
PO No. : N7912-P99264
Project : CTO #68

WIC#: CNC CHARLESTON REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
27GLM0101	Aqueous	CLIENT	09/23/99	09/24/99

PARAMETER	RESULT	UNITS	DF	*PQL	METHOD	ANALYZED	BY	NOTES
Nitrate as N	<0.050	mg/L	1.0	0.050	353.2	09/24/99	KW	
Sulfate	16.	mg/L	2.0	1.0	375.4	10/12/99	KW	

* PQL (Practical Quantitation Level) represents laboratory reporting limits and may not reflect sample-specific reporting limits. Sample-specific limits are indicated by results annotated with '<' values.

10/27/99

LJO/baeajc(dw)/msm
PI24NOW2
CC: MS. LEE LECK
TETRATECH NUS
FOSTER PLAZA 7
661 ANDERSEN DR.

ORGANICS ANALYSIS DATA SHEET 27GLM0101

EPA SAMPLE NO.

Lab Name: ENSR Contract: WP4075-15(B)

Lab Code: Case No.: SAS NO.: SDG NO.:

Matrix: (soil/water) water

Lab Sample ID: 990181-1

Sample wt / vol: 32.5 ml (g/ml)

Lab File ID: KTH_013

Level: (low/med) low

Date Received: 9/28/99

% Moisture: NA

Date Analyzed: 10/5/99

GC Column: Carboxen 1004 OD: 1/16"

Dilution Factor: 1

Soil Extract Volume: NA (µl)

Soil Aliquot Volume: NA (µl)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (µg/L or PPMv) µg/L	Q
74-82-8	Methane	40	

27GLM0101

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308
Proj. ID: CNC CHARLESTON

Lab Number:	WP4075-20
SDG:	WP4075
Report Date:	10/15/99
PO No. :	N7912-P99264
Project:	CTO #68
% Solids:	N/A
Method:	SW8260
Date Analyzed:	9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLM0101D	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	<5	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	104	%	1.0		
2-DICHLOROETHANE-D4	107	%	1.0		
OLUENE-D8	102	%	1.0		
P-BROMOFLUOROBENZENE	101	%	1.0		

Report Notes:

0000046

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-5
SDG: WP4075
Report Date: 10/9/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/5/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLM0101D	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<11	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	<11	ug/L	1.1	11	10
FLUORENE	<11	ug/L	1.1	11	10
PHENANTHRENE	<11	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	76	%	1.1		
2-FLUOROBIPHENYL	80	%	1.1		
TERPHENYL-D14	90	%	1.1		

Report Notes: A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services | **Client Field ID:** 27GLM0101D

Matrix: WATER | **SDG Name:** WP4075

Percent Solids: 0.00 | **Lab Sample ID:** WP4075-005

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	542			P	1
7440-36-0	ANTIMONY	5.0	B		P	1
7440-38-2	ARSENIC	8.4			P	1
7440-39-3	BARIUM	47.0			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	1.94	U		P	1
7440-70-2	CALCIUM	56500			P	1
7440-47-3	CHROMIUM	4.6	B		P	1
7440-48-4	COBALT	4.9	B		P	1
7440-50-8	COPPER	78.7			P	1
7439-89-6	IRON	2840			P	1
7439-92-1	LEAD	17.5			P	1
7439-95-4	MAGNESIUM	1530			P	1
7439-96-5	MANGANESE	110			P	1
7439-97-6	MERCURY	0.04	B		CV	1
7440-02-0	NICKEL	13.21	U		P	1
7440-09-7	POTASSIUM	2270			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	6560			P	1
7440-28-0	THALLIUM	8.6	B		P	1
7440-62-2	VANADIUM	3.58	U		P	1
7440-66-6	ZINC	99.2			P	1

Comments:

ORGANICS ANALYSIS DATA SHEET 27GLM0101

EPA SAMPLE NO.

Lab Name: _____ ENSR _____ Contract: _____ WP4075-15(B) RE

Lab Code: _____ Case No.: _____ SAS NO.: _____ SDG NO.: _____

Matrix: (soil/water) _____ water _____ Lab Sample ID: 990181-1 DUP

Sample wt / vol: ____ 32.5 ml _____ (g/ml) Lab File ID: ___KTH_014_____

Level: (low/med) _____ low _____ Date Received:___9/28/99 _____

% Moisture: _____ NA _____ Date Analyzed:___10/5/99 _____

GC Column: _ Carboxen 1004 __ OD: ___ 1/16" ___ Dilution Factor:_____1_____

Soil Extract Volume: _____ NA ____ (µl) Soil Aliquot Volume: ____ NA ____ (µl)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (µg/L or PPMv) __ µg/L __	Q
74-82-8	Methane	39	

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

ent: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-17
SDG: WP4075
Report Date: 10/15/99
PO No.: N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0301	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	17	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	105	%	1.0		
1,2-DICHLOROETHANE-D4	105	%	1.0		
TOLUENE-D8	102	%	1.0		
P-BROMOFLUOROBENZENE	101	%	1.0		

Report Notes:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-1
SDG: WP4075
Report Date: 10/9/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/4/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0301	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<11	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	<11	ug/L	1.1	11	10
FLUORENE	<11	ug/L	1.1	11	10
PHENANTHRENE	<11	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	83	%	1.1		
2-FLUOROBIPHENYL	85	%	1.1		
TERPHENYL-D14	92	%	1.1		

Report Notes: A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** 27GLX0301

Matrix: WATER **SDG Name:** WP4075

Percent Solids: 0.00 **Lab Sample ID:** WP4075-017

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	4560			P	1
7440-36-0	ANTIMONY	73.9			P	1
7440-38-2	ARSENIC	9.4			P	1
7440-39-3	BARIUM	19.9			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	1.94	U		P	1
7440-70-2	CALCIUM	16600			P	1
7440-47-3	CHROMIUM	133			P	1
7440-48-4	COBALT	4.45	U		P	1
7440-50-8	COPPER	185			P	1
7439-89-6	IRON	1940			P	1
7439-92-1	LEAD	675			P	1
7439-95-4	MAGNESIUM	548			P	1
7439-96-5	MANGANESE	28.1			P	1
7439-97-6	MERCURY	0.34			CV	1
7440-02-0	NICKEL	16.5	B		P	1
7440-09-7	POTASSIUM	10300			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	146000			P	1
7440-28-0	THALLIUM	4.49	U		P	1
7440-62-2	VANADIUM	41.0			P	1
7440-66-6	ZINC	582			P	1

Comments:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-18
SDG: WP4075
Report Date: 10/15/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0401	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	7	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	106	%	1.0		
1,2-DICHLOROETHANE-D4	106	%	1.0		
TOLUENE-D8	102	%	1.0		
P-BROMOFLUOROBENZENE	100	%	1.0		

Report Notes:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308
Proj. ID: CNC CHARLESTON

Lab Number: WP4075-2
SDG: WP4075
Report Date: 10/9/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/5/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0401	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	J6	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	<11	ug/L	1.1	11	10
FLUORENE	<11	ug/L	1.1	11	10
PHENANTHRENE	<11	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	103	%	1.1		
2-FLUOROBIPHENYL	101	%	1.1		
TERPHENYL-D14	97	%	1.1		

Report Notes: J, A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services
Client Field ID: 27GLX0401

Matrix: WATER
SDG Name: WP4075

Percent Solids: 0.00
Lab Sample ID: WP4075-018

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	107			P	1
7440-36-0	ANTIMONY	8.2			P	1
7440-38-2	ARSENIC	3.8	B		P	1
7440-39-3	BARIUM	19.9			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	1.94	U		P	1
7440-70-2	CALCIUM	67200			P	1
7440-47-3	CHROMIUM	4.31	U		P	1
7440-48-4	COBALT	4.45	U		P	1
7440-50-8	COPPER	1.62	U		P	1
7439-89-6	IRON	198			P	1
7439-92-1	LEAD	1.09	U		P	1
7439-95-4	MAGNESIUM	1680			P	1
7439-96-5	MANGANESE	26.0			P	1
7439-97-6	MERCURY	0.02	U		CV	1
7440-02-0	NICKEL	13.21	U		P	1
7440-09-7	POTASSIUM	5680			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	71800			P	1
7440-28-0	THALLIUM	4.49	U		P	1
7440-62-2	VANADIUM	3.58	U		P	1
7440-66-6	ZINC	23.4	B		P	1

Comments:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

ent: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308
Proj. ID: CNC CHARLESTON

Lab Number: WP4075-19
SDG: WP4075
Report Date: 10/15/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX4D01	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	<5	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	104	%	1.0		
'-DICHLOROETHANE-D4	106	%	1.0		
OLUENE-D8	103	%	1.0		
P-BROMOFLUOROBENZENE	102	%	1.0		

Report Notes:

0000045

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-3
SDG: WP4075
Report Date: 10/9/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/4/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX4D01	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<11	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	18	ug/L	1.1	11	10
FLUORENE	16	ug/L	1.1	11	10
PHENANTHRENE	<11	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	84	%	1.1		
2-FLUOROBIPHENYL	91	%	1.1		
TERPHENYL-D14	102	%	1.1		

Report Notes: A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** 27GLX4D01

Matrix: WATER **SDG Name:** WP4075

Percent Solids: 0.00 **Lab Sample ID:** WP4075-019

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	38.0	B		P	1
7440-36-0	ANTIMONY	1.81	U		P	1
7440-38-2	ARSENIC	31.8			P	1
7440-39-3	BARIUM	65.4			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	1.94	U		P	1
7440-70-2	CALCIUM	34600			P	1
7440-47-3	CHROMIUM	4.31	U		P	1
7440-48-4	COBALT	4.45	U		P	1
7440-50-8	COPPER	1.7	B		P	1
7439-89-6	IRON	19000			P	1
7439-92-1	LEAD	1.09	U		P	1
7439-95-4	MAGNESIUM	24700			P	1
7439-96-5	MANGANESE	528			P	1
7439-97-6	MERCURY	0.02	U		CV	1
7440-02-0	NICKEL	13.21	U		P	1
7440-09-7	POTASSIUM	10700			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	254000			P	1
7440-28-0	THALLIUM	4.49	U		P	I
7440-62-2	VANADIUM	3.58	U		P	1
7440-66-6	ZINC	10.5	B		P	1

Comments:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-16
SDG: WP4075
Report Date: 10/15/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0501	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	<5	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	105	%	1.0		
1,2-DICHLOROETHANE-D4	106	%	1.0		
TOLUENE-D8	102	%	1.0		
P-BROMOFLUOROBENZENE	101	%	1.0		

Report Notes:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-6
SDG: WP4075
Report Date: 10/9/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/5/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0501	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<11	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	<11	ug/L	1.1	11	10
FLUORENE	<11	ug/L	1.1	11	10
PHENANTHRENE	<11	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	65	%	1.1		
2-FLUOROBIPHENYL	66	%	1.1		
TERPHENYL-D14	76	%	1.1		

Report Notes: A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** 27GLX0501

Matrix: WATER **SDG Name:** WP4075

Percent Solids: 0.00 **Lab Sample ID:** WP4075-016

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	236			P	1
7440-36-0	ANTIMONY	1.81	U		P	1
7440-38-2	ARSENIC	16.3			P	1
7440-39-3	BARIUM	17.0			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	1.94	U		P	1
7440-70-2	CALCIUM	96800			P	1
7440-47-3	CHROMIUM	4.31	U		P	1
7440-48-4	COBALT	4.45	U		P	1
7440-50-8	COPPER	3.4	B		P	1
7439-89-6	IRON	5600			P	1
7439-92-1	LEAD	4.9	B		P	1
7439-95-4	MAGNESIUM	6910			P	1
7439-96-5	MANGANESE	814			P	1
7439-97-6	MERCURY	0.02	U		CV	1
7440-02-0	NICKEL	13.21	U		P	1
7440-09-7	POTASSIUM	10200			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	17700			P	1
7440-28-0	THALLIUM	4.49	U		P	1
7440-62-2	VANADIUM	3.58	U		P	1
7440-66-6	ZINC	12.4	B		P	1

Comments:

Katahdin
ANALYTICAL SERVICES

CLIENT: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr., Suite 102
Tallahassee, FL 32308

Lab Number : WP-4075-6
Report Date: 10/27/99
PO No. : N7912-P99264
Project : CTO #68

WIC#: CNC CHARLESTON REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
27GLX0501	Aqueous	CLIENT	09/23/99	09/24/99

PARAMETER	RESULT	UNITS	DF	*PQL	METHOD	ANALYZED	BY	NOTES
Nitrate as N	<0.050	mg/L	1.0	0.050	353.2	09/24/99	KW	
Sulfate	92.	mg/L	10	1.0	375.4	10/12/99	KW	

* PQL (Practical Quantitation Level) represents laboratory reporting limits and may not reflect sample-specific reporting limits. Sample-specific limits are indicated by results annotated with '<' values.

10/27/99

LJO/baeajc(dw)/msm
PI24NOW2
CC: MS. LEE LECK
TETRATECH NUS
FOSTER PLAZA 7
661 ANDERSEN DR.

ORGANICS ANALYSIS DATA SHEET

27GLX0501
EPA SAMPLE NO.

Lab Name: _____ ENSR _____ Contract: _____ WP4075-16(A)

Lab Code: _____ Case No.: _____ SAS NO.: _____ SDG NO.: _____

Matrix: (soil/water) _____ water _____ Lab Sample ID: 990181-2

Sample wt / vol: ____ 32.5 ml _____ (g/ml) Lab File ID: ___KTH_015_____

Level: (low/med) _____ low _____ Date Received:___9/28/99 _____

% Moisture: _____ NA _____ Date Analyzed:___10/5/99 _____

GC Column: _ Carboxen 1004 __ OD: ___ 1/16" ___ Dilution Factor:_____ 1 _____

Soil Extract Volume: _____ NA ____ (µl) Soil Aliquot Volume: ____ NA ____ (µl)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (µg/L or PPMv) __ µg/L __	Q
74-82-8	Methane	450	

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-42
SDG: WP4075
Report Date: 10/15/99
PO No.: N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0701	AQ	9/23/99	9/25/99	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	<5	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	100	%	1.0		
1,2-DICHLOROETHANE-D4	103	%	1.0		
TOLUENE-D8	98	%	1.0		
P-BROMOFLUOROBENZENE	97	%	1.0		

Report Notes:

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: WP4075-10
SDG: WP4075
Report Date: 10/9/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/5/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
27GLX0701	AQ	9/23/99	9/24/99	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<11	ug/L	1.1	11	10
2-METHYLNAPHTHALENE	<11	ug/L	1.1	11	10
ACENAPHTHYLENE	<11	ug/L	1.1	11	10
ACENAPHTHENE	32	ug/L	1.1	11	10
FLUORENE	19	ug/L	1.1	11	10
PHENANTHRENE	J10	ug/L	1.1	11	10
ANTHRACENE	<11	ug/L	1.1	11	10
FLUORANTHENE	<11	ug/L	1.1	11	10
PYRENE	<11	ug/L	1.1	11	10
BENZO[A]ANTHRACENE	<11	ug/L	1.1	11	10
CHRYSENE	<11	ug/L	1.1	11	10
BENZO[B]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[K]FLUORANTHENE	<11	ug/L	1.1	11	10
BENZO[A]PYRENE	<11	ug/L	1.1	11	10
INDENO[1,2,3-CD]PYRENE	<11	ug/L	1.1	11	10
DIBENZ[A,H]ANTHRACENE	<11	ug/L	1.1	11	10
BENZO[G,H,I]PERYLENE	<11	ug/L	1.1	11	10
NITROBENZENE-D5	65	%	1.1		
2-FLUOROBIPHENYL	68	%	1.1		
TERPHENYL-D14	83	%	1.1		

Report Notes: J, A-1

INORGANIC ANALYSIS DATA SHEET

Lab Name: Katahdin Analytical Services **Client Field ID:** 27GLX0701

Matrix: WATER **SDG Name:** WP4075

Percent Solids: 0.00 **Lab Sample ID:** WP4075-010

Concentration Units (ug/L or mg/Kg dry weight): ug/L

CAS No.	Analyte	Concentration	C	Q	M	DF
7429-90-5	ALUMINUM	77.4	B		P	1
7440-36-0	ANTIMONY	1.81	U		P	1
7440-38-2	ARSENIC	4.3	B		P	1
7440-39-3	BARIUM	80.3			P	1
7440-41-7	BERYLLIUM	0.33	U		P	1
7440-43-9	CADMIUM	1.94	U		P	1
7440-70-2	CALCIUM	77700			P	1
7440-47-3	CHROMIUM	4.31	U		P	1
7440-48-4	COBALT	4.45	U		P	1
7440-50-8	COPPER	2.5	B		P	1
7439-89-6	IRON	3220			P	1
7439-92-1	LEAD	2.2	B		P	1
7439-95-4	MAGNESIUM	13000			P	1
7439-96-5	MANGANESE	279			P	1
7439-97-6	MERCURY	0.02	U		CV	1
7440-02-0	NICKEL	13.21	U		P	1
7440-09-7	POTASSIUM	15000			P	1
7782-49-2	SELENIUM	2.57	U		P	1
7440-22-4	SILVER	2.54	U		P	1
7440-23-5	SODIUM	45800			P	1
7440-28-0	THALLIUM	4.49	U		P	1
7440-62-2	VANADIUM	3.58	U		P	1
7440-66-6	ZINC	36.4			P	1

Comments:

Katahdin
ANALYTICAL SERVICES

CLIENT: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr., Suite 102
Tallahassee, FL 32308

Lab Number : WP-4075-10
Report Date: 10/27/99
PO No. : N7912-P99264
Project : CTO #68

WIC#: CNC CHARLESTON REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
27GLX0701	Aqueous	CLIENT	09/23/99	09/24/99

PARAMETER	RESULT	UNITS	DF	*PQL	METHOD	ANALYZED	BY	NOTES
Nitrate as N	<0.050	mg/L	1.0	0.050	353.2	09/24/99	KW	
Sulfate	<1.0	mg/L	1.0	1.0	375.4	10/11/99	CF	

* PQL (Practical Quantitation Level) represents laboratory reporting limits and may not reflect sample-specific reporting limits. Sample-specific limits are indicated by results annotated with '<' values.

10/27/99

LJO/baeajc(dw)/msm
PI24NOW2
CC: MS. LEE LECK
TETRATECH NUS
FOSTER PLAZA 7
661 ANDERSEN DR.

ORGANICS ANALYSIS DATA SHEET

27GLX0701
EPA SAMPLE NO.

Lab Name: ENSR Contract: WP4075-42(A)

Lab Code: Case No.: SAS NO.: SDG NO.:

Matrix: (soil/water) water

Lab Sample ID: 990181-4

Sample wt / vol: 32.5 ml (g/ml)

Lab File ID: KTH_017

Level: (low/med) low

Date Received: 9/28/99

% Moisture: NA

Date Analyzed: 10/5/99

GC Column: Carboxen 1004 OD: 1/16"

Dilution Factor: 1

Soil Extract Volume: NA (µl)

Soil Aliquot Volume: NA (µl)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (µg/L or PPMv) µg/L	Q
74-82-8	Methane	5400	E

ORGANICS ANALYSIS DATA SHEET

27GLX0701
EPA SAMPLE NO.

Lab Name: _____ ENSR _____ Contract: _____ WP4075-42(A) D

Lab Code: _____ Case No.: _____ SAS NO.: _____ SDG NO.: _____

Matrix: (soil/water) _____ water _____ Lab Sample ID: 990181-4 DIL

Sample wt / vol: ____ 32.5 ml _____ (g/ml) Lab File ID: ___ KTH_019_____

Level: (low/med) _____ low _____ Date Received:___9/28/99 _____

% Moisture: _____ NA _____ Date Analyzed:___10/5/99 _____

GC Column: _ Carboxen 1004 __ OD: ___ 1/16" ___ Dilution Factor:_____ 144 _____

Soil Extract Volume: _____ NA ____ (µl) Soil Aliquot Volume: ____ NA ____ (µl)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (µg/L or PPMv) __ µg/L __	Q
74-82-8	Methane	8800	D

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: SBLK;092899
SDG: WP4075
Report Date: 10/9/99
PO No.: N7912-P99264
Project: CTO #68
% Solids: N/A
Method: EPA 8270
Date Analyzed: 10/4/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
SBLK;092899	AQ	-	-	9/28/99	DS	SW3510	KRT

Compound	Result	Units	DF	Sample PQL	Method PQL
NAPHTHALENE	<10	ug/L	1.0	10	10
2-METHYLNAPHTHALENE	<10	ug/L	1.0	10	10
ACENAPHTHYLENE	<10	ug/L	1.0	10	10
ACENAPHTHENE	<10	ug/L	1.0	10	10
FLUORENE	<10	ug/L	1.0	10	10
PHENANTHRENE	<10	ug/L	1.0	10	10
ANTHRACENE	<10	ug/L	1.0	10	10
FLUORANTHENE	<10	ug/L	1.0	10	10
PYRENE	<10	ug/L	1.0	10	10
BENZO[A]ANTHRACENE	<10	ug/L	1.0	10	10
CHRYSENE	<10	ug/L	1.0	10	10
BENZO[B]FLUORANTHENE	<10	ug/L	1.0	10	10
BENZO[K]FLUORANTHENE	<10	ug/L	1.0	10	10
BENZO[A]PYRENE	<10	ug/L	1.0	10	10
INDENO[1,2,3-CD]PYRENE	<10	ug/L	1.0	10	10
DIBENZ[A,H]ANTHRACENE	<10	ug/L	1.0	10	10
BENZO[G,H,I]PERYLENE	<10	ug/L	1.0	10	10
NITROBENZENE-D5	87	%	1.0		
2-FLUOROBIPHENYL	90	%	1.0		
TERPHENYL-D14	114	%	1.0		

Report Notes:

0000139

KATAHDIN ANALYTICAL SERVICES
REPORT OF ANALYTICAL RESULTS

Client: Paul Calligan
Tetra Tech NUS
1401 Oven Park Dr.
Suite 102
Tallahassee, FL 32308

Proj. ID: CNC CHARLESTON

Lab Number: VBLKU28A
SDG: WP4075
Report Date: 10/15/99
PO No. : N7912-P99264
Project: CTO #68
% Solids: N/A
Method: SW8260
Date Analyzed: 9/28/99

Sample Description	Matrix	Sampled Date	Rec'd Date	Ext. Date	Ext'd By	Ext. Method	Analyst
VBLKU28A	AQ	-	-	9/28/99	HMP	5030	HMP

Compound	Result	Units	DF	Sample PQL	Method PQL
BENZENE	<5	ug/L	1.0	5	5
TOLUENE	<5	ug/L	1.0	5	5
1,2-DIBROMOETHANE	<5	ug/L	1.0	5	5
ETHYLBENZENE	<5	ug/L	1.0	5	5
NAPHTHALENE	<5	ug/L	1.0	5	5
MTBE	<5	ug/L	1.0	5	5
TOTAL XYLENES	<5	ug/L	1.0	5	5
DIBROMOFLUOROMETHANE	101	%	1.0		
1,2-DICHLOROETHANE-D4	101	%	1.0		
TOLUENE-D8	100	%	1.0		
P-BROMOFLUOROBENZENE	99	%	1.0		

Report Notes:

Katahdin
ANALYTICAL SERVICES
340 County Road No. 5
P.O. Box 720
Westbrook, ME 04092
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY

PLEASE PRINT IN PEN

Client	Contact	Phone #	Fax #
NUS	Paul Calligan	(843) 554-4925	( )

Address	City	State	Zip Code
NH-21 Aveth	N. Charleston	SC	

Purchase Order # | Proj. Name / No. Charleston Navel Complex | Katahdin Quote #

Bill (if different than above) | Address

Sampler (Print / Sign) Jennifer Elliott | Copies To:

LAB USE ONLY WORK ORDER #: WP4075

KATAHDIN PROJECT MANAGER

REMARKS:

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO:

TEMP°C ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

ANALYSIS AND CONTAINER TYPE PRESERVATIVES

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Filt. Y N: 8260 BTEX, EDB, Naph, MTBE	Filt. Y N: Dissolved Methane	Filt. Y N: PAHs	Filt. Y N: Metals	Filt. Y N: Anions	Filt. Y N	Filt. Y N	Filt. Y N	Filt. Y N	Filt. Y N	Filt. Y N
	27GLM01	9-23/1050	GW		3	3	2	1	1						
	27GLX03	9-23/1010			3		2	1							
	27GLX04	9-23/1010			3		2	1							
	27GLX40	9-23/1012			3		2	1							
	27GLX05	9-23/1100			3	3	2	1	1						
	27GLX07	9-23/1120			3	3	2	1	1						
	27GLM01	9-23/—			3	3	2	1	1						
	28GLM03	9-23/1645			3	3	2	1							
	28GLM02	9-23/1640			3	3	2	1							
	28GLM01	9-23/—			3	3	2	1	1						
	28TL00	9-23/			2										
		/													
		/													
		/													
		/													
		/													

+ cooler (BK) 2 OF 3 → 4 OF 5

COMMENTS

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
	9/23/1850	Fed-Ex	8134583609293	9-25-99 (08)	
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

Katahdin ANALYTICAL SERVICES
340 County Road No. 5
P.O. Box 720
Westbrook, ME 04092
Tel: (207) 874-2400
Fax: (207) 775-4029

CHAIN of CUSTODY

Page 1 of 1

PLEASE PRINT IN PEN

Client	Contact	Phone #	Fax #
Katahdin Analytical Services	Amanda H.	( )	( )

Address	City	State	Zip Code
as above			

Purchase Order #	Proj. Name / No.	Katahdin Quote #

Bill (if different than above)	Address

Sampler (Print / Sign)	Copies To:

LAB USE ONLY WORK ORDER #: _*

KATAHDIN PROJECT MANAGER _____

REMARKS: Send to ENSR

SHIPPING INFO: ☑ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO: _____

TEMP°C _____ ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	ANALYSIS AND CONTAINER TYPE PRESERVATIVES: Filt. Y O N (Dissolved Methane)	Filt. Y O N	Filt. Y O N (Lab IDs)	Filt. Y O N (Lab IDs)	Filt. Y O N	Filt. Y O N (Sample IDs)	Filt. Y O N	Filt. Y O N	Filt. Y O N	Filt. Y O N
	WP 4075-15	9.23.99 / 1050	AQ	3	X			9911321-1		(27GLM0401) ✓				
	WP 4075-16	↓ / 1100	↓	↓	X					(27GLX0501) ✓				
	WP 4075-39	9.24.99 / 0840			X					(Site 28)				
	WP 4075-42	9.23.99 / 1126			X					(27GLX0701) ✓				
	WP 4075-43	↓ / 1145			X					(Site 28)				
	WP 4075-44	↓ / 1140	↓	↓	X					(Site 28)				
		/												
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COMMENTS

QC-II + D/Narrative DD (KA5007QC-DE3) Results Due: 10.2.99

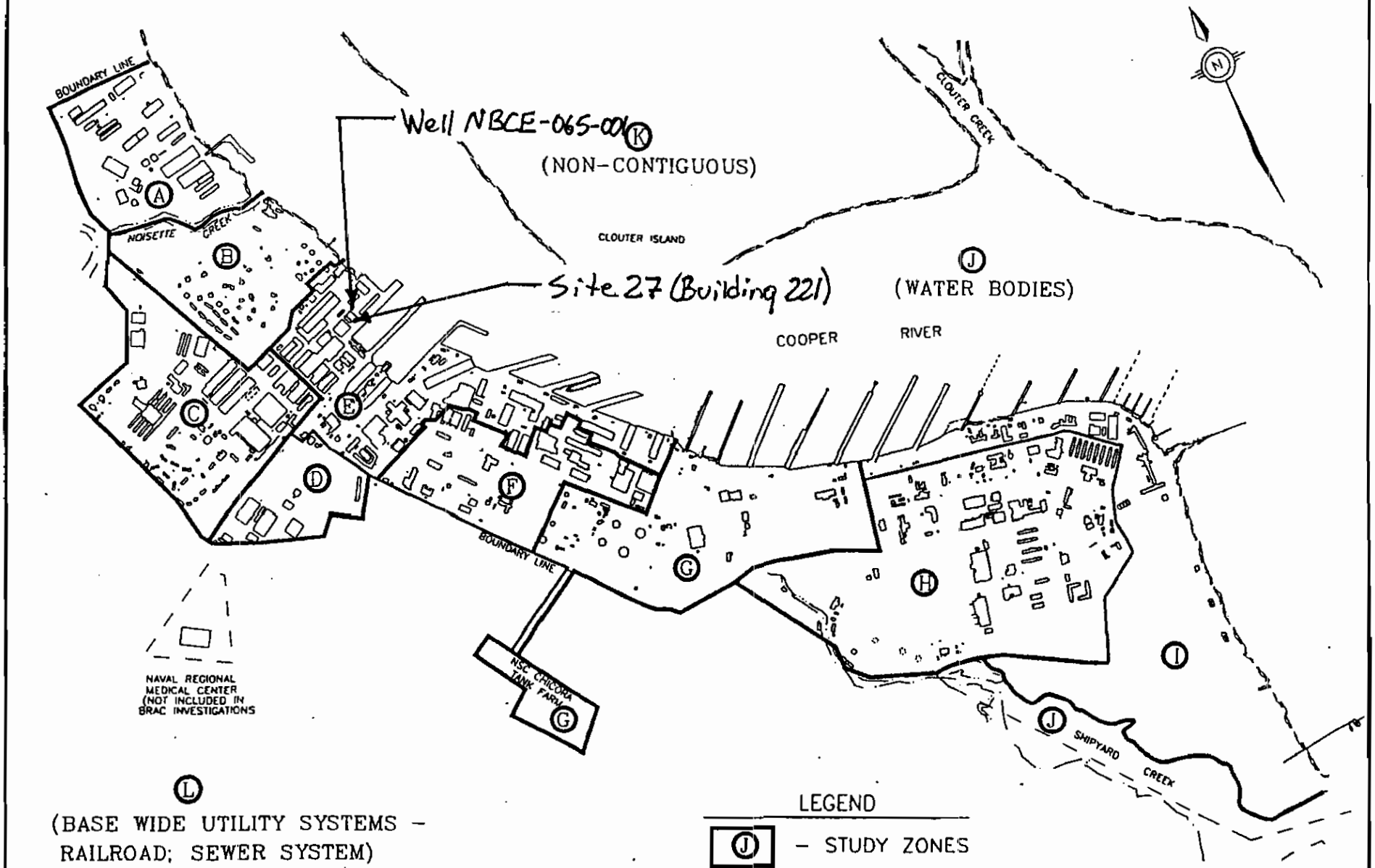
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
[signature]	9.27.99 1600			9.28.99 1230	[signature]
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

FORMSOURCE INC. ☎ (207) 782-3311
FORM # CHN-OF-CSTDY

DUPLICATE

APPENDIX E

AQUIFER CHARACTERIZATION GRAPHS



ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

INVESTIGATIVE
ZONE BOUNDARIES

DWG DATE: 09/29/97 | DWG NAME: ZEZMAP

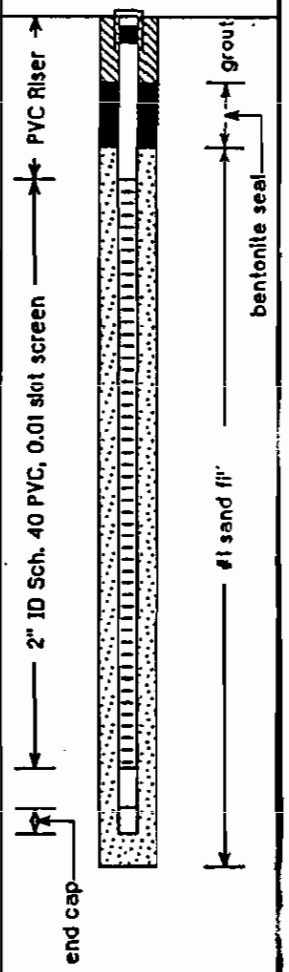
EnSafe/Allen & Hoshall

Monitoring Well NBCE065001

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2317543.39 E, 377256.57 N*
Location: *Charleston, SC*	Surface Elevation: *7.1 feet msl*
Started at *1000 on 12-7-95*	TOC Elevation: *6.92 feet msl*
Completed at *1150 on 12-7-95*	Depth to Groundwater: *2.78 feet TOC* Measured: *3/13/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *4.14 feet msl*
Drilling Company: *Atlantic Drilling (SC cert #1210*	Total Well Depth: *12.5 feet bgs*
Geologist: *B. Blythe*	Well Screen: *2.5 to 11.5 feet bgs*

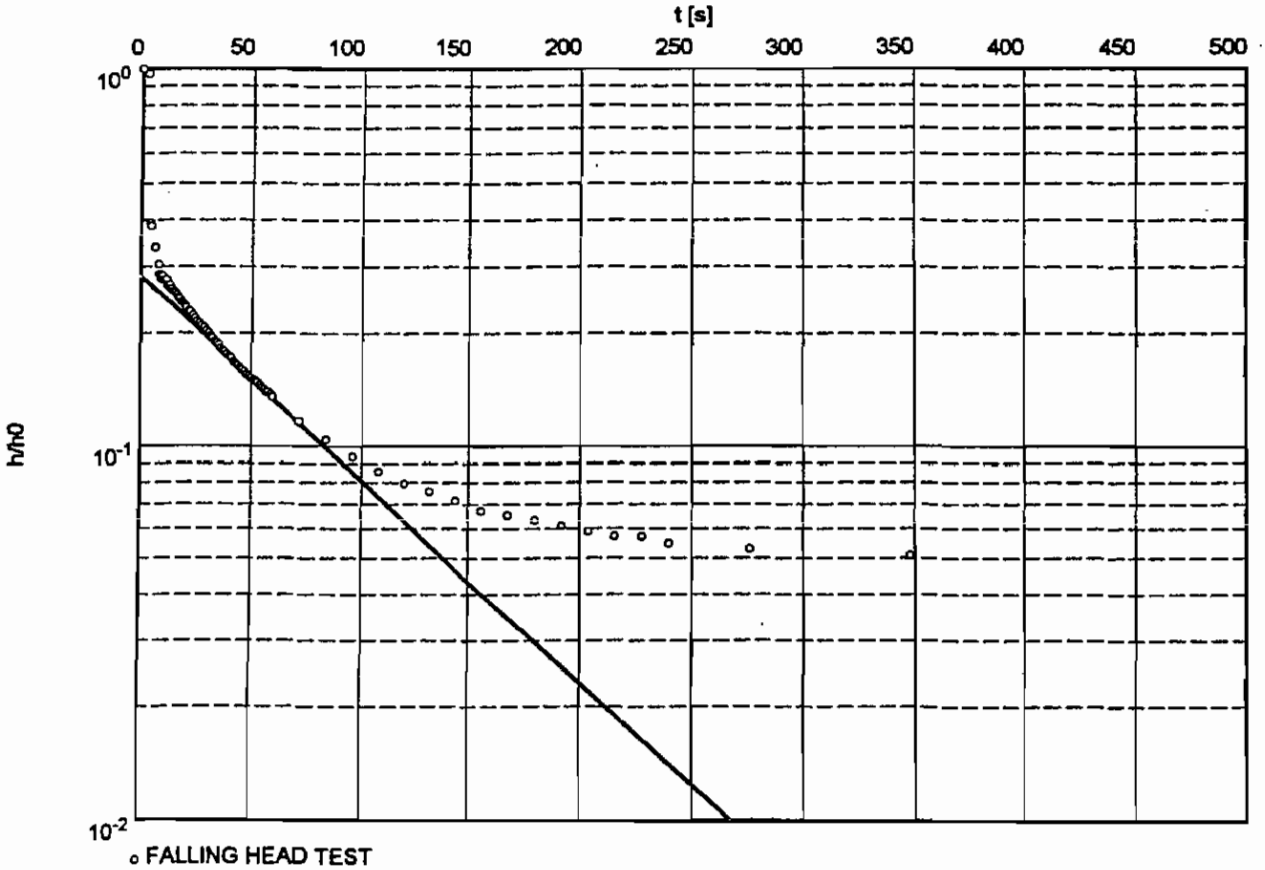
DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: concrete walk	
							SM	Sand: light brown, gravelly, muddy, dry to moist.	3.1
							GM		2.8
5							OL	Clay: dark gray-black, high organic content, fat, soft, moist to wet, low plasticity, H_2S odor --Marsh clay.	1.9
			1	60	0				
							OL	Clay: Marsh clay as above.	.9
							PT	Peat: dark brown with light brown root material and grass fibers, soft, moist, H_2S odor.	1.6
10			2	85	0				2.6
							PT	Peat: as above with interbedded clay laminae throughout.	3.9
			3	100	0				5.9
15									
20									

WELL DIAGRAM



EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Suite 113 Mt. Pleasant, SC 29464 (803)-884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix C, Page 1 Project: ZONE E--NAVBASE CHARLESTON Evaluated by: TKK | Date: 13.11.96

Slug Test No. 1	Test conducted on: 18.10.96
NBCE-065-001	



o FALLING HEAD TEST

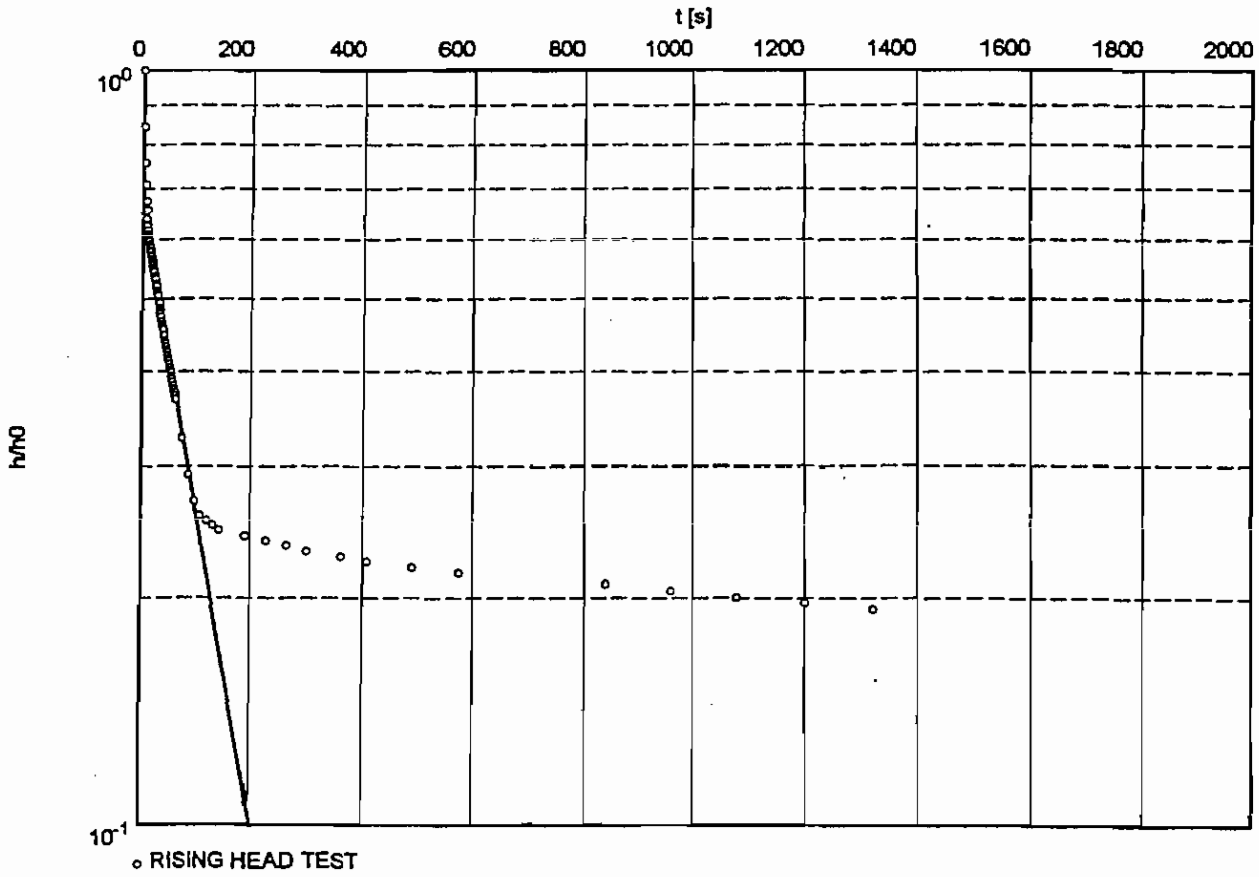
Hydraulic conductivity [ft/s]: 4.42×10^{-4}

Hydraulic conductivity [ft/day]: 38.2

L = 1.7 ft
b = 10.4 ft
D = 10.4 ft (full penetration)

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Suite 113 Mt. Pleasant, SC 29464 (803)-884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix C, Page 1	
		Project: ZONE E--NAVBASE CHARLESTON	
		Evaluated by: TKK	Date: 13.11.96

Slug Test No. 1	Test conducted on: 18.10.96
NBCE-065-001	



Hydraulic conductivity [ft/s]: 3.23×10^{-4}

Hydraulic conductivity [ft/day]: 27.9

L = 1.7 ft
b = 10.4 ft
D = 10.4 ft (full penetration)

APPENDIX F

RBCA CALCULATIONS

Construction Worker Dermal RBSLs

	Kow	MW	Kp	B	τ_{event}	c	b	t*	t_{event}	DAevent
			cm/hr	unitless	hr/event			hr	hr/event	
Benzene	199.5262315	78.1	0.11551543	0.392637855	2.87E-01	6.32E-01	6.03E-01	6.90E-01	1	eq 3.3
Toluene	537.0317964	92.1	0.259561335	0.958068292	3.44E-01	1.13E+00	1.31E+00	1.33E+00	1	eq 3.2
Ethylbenzene	1412.537545	106.2	0.569219802	2.256154884	4.13E-01	2.36E+00	4.39E+00	1.70E+00	1	eq 3.2
Xylene*	1584.893192	106.2	0.638675123	2.531447415	4.13E-01	2.63E+00	5.31E+00	1.72E+00	1	eq 3.2
Naphthalene	1995.262315	128.2	0.605452393	2.636638957	5.48E-01	2.73E+00	5.69E+00	2.29E+00	1	eq 3.2
MTBE	15.136	88.15	0.00769788	0.027797704	3.27E-01	3.52E-01	3.20E-01	7.85E-01	1	eq 3.3
Chrysene	457088	228.3	0.49	2.847578386	1.99E+00	2.93E+00	6.49E+00	8.39E+00	1	eq 3.2
Chromium VI									1	
Lead										

	BW	AT	EV	ED	EF	SA	CSF derm	Rfd derm	Target	RBSL	RBSL
	kg	day	events/day	yrs	days/yr	cm^2	$(mg/kg\text{-}day)^{-1}$	mg/kg-day	Risk or HQ	mg/L	mg/L
Benzene	70	25550	1	1	90	4500	2.99E-02	NA	1.00E-06		8.52E-01
Toluene	70	365	1	1	90	4500	NA	1.60E-01	1.0	2.40E+01	
Ethylbenzene	70	365	1	1	90	4500	NA	9.70E-02	1.0	6.05E+00	
Xylene*	70	365	1	1	90	4500	NA	1.84E+00	1.0	1.02E+02	
Naphthalene	70	365	1	1	90	4500	NA	3.20E-02	1.0	1.63E+00	
MTBE	70	365	1	1	90	4500	NA	5.00E-03	1.0	2.59E+01	
Chrysene	70	25550	1	1	90	4500	1.46E-02	NA	1.00E-06		3.23E-01
Chromium VI	70	365	1	1	90	4500		7.50E-05	1.0	2.37E+00	
Lead											

* Kow and MW values for xylene, m-

There are no toxicity values for lead; therefore, a dermal RBSL for a construction worker cannot be calculated.

Prepared By: Greg Swanson (G. M. Dorf)

Reviewed By:

Construction Worker Incidental Ingestion RBSLs

	BW	AT	IR	ED	EF	Target	CSF oral	Rfd oral	RBSL
	kg	day	L/day	yrs	days/yr	Risk or HQ			mg/L
Benzene	70	25550	0.01	1	90	1.00E-06	2.90E-02	NA	6.85E+01
Toluene	70	365	0.01	1	90	1.0	NA	2.00E-01	5677.778
Ethylbenzene	70	365	0.01	1	90	1.0	NA	1.00E-01	2838.889
Xylene	70	365	0.01	1	90	1.0	NA	2.00E+00	56777.78
Naphthalene	70	365	0.01	1	90	1.0	NA	4.00E-02	1135.556
MTBE	70	365	0.01	1	90	1.0	NA	5.00E-03	141.9444
Chrysene	70	25550	0.01	1	90	1.00E-06	7.30E-03	NA	2.72E+02
ChromiumVI	70	365	0.01	1	90	1	NA	3.00E-03	1.0
Lead									

* No CSF oral or Rfd oral are available for Lead, therefore the incidental ingestion RBSL for a construction worker cannot be calculated.

Prepared By: Greg Swanson

Reviewed By:

Construction Worker Inhalation RBSLs

Chemical			Dair	Dwater	H	θ_{wcrit}	θ_{wwp}	θ_{ws}	θ_{as}	θ_T	Deff-cap	Deff-s
			cm²/s	cm²/s	cm³/cm³	cm³/cm³	cm³/cm³	cm³/cm³	cm³/cm³	cm³/cm³	cm²/s	cm²/s
Benzene			0.093	1.10E-05	2.26E-01	0.038	0.342	0.33	0.15	0.48	1.35E-05	1.01E-02
Toluene			0.085	9.40E-06	3.01E-01	0.038	0.342	0.33	0.15	0.48	1.07E-05	9.20E-03
Ethylbenzene			0.076	8.50E-06	2.80E-01	0.038	0.342	0.33	0.15	0.48	9.85E-06	8.22E-03
Xylenes			0.072	8.50E-06	2.78E-01	0.038	0.342	0.33	0.15	0.48	9.55E-06	7.79E-03
Naphthalene			0.072	9.40E-06	2.00E-03	0.038	0.342	0.33	0.15	0.48	5.79E-04	7.83E-03
MTBE			0.102	1.05E-05	4.16E-02	0.038	0.342	0.33	0.15	0.48	3.90E-05	1.10E-02
Chrysene			2.49E-02	6.21E-06	3.02E-18	0.038	0.342	0.33	0.15	0.48	2.51E+11	1.81E+10
ChromiumVI						0.038	0.342	0.33	0.15	0.48		
Lead									1			

Chemical			hcap	hv	Deff-ws	Uair	Sair	Lgw	W	VFwamb	TR (carc)	HI (nonc)
			cm	cm	cm²/s	cm/sec	cm	cm	cm	mg/m³/mg/L		
Benzene			5	117	3.18E-04	225	200	122	1500	1.97E-05	1.00E-06	NA
Toluene			5	117	2.54E-04	225	200	122	1500	2.09E-05	NA	1
Ethylbenzene			5	117	2.34E-04	225	200	122	1500	1.79E-05	NA	1
Xylenes			5	117	2.27E-04	225	200	122	1500	1.72E-05	NA	1
Naphthalene			5	117	5.17E-03	225	200	122	1500	2.83E-06	NA	1
MTBE			5	117	8.79E-04	225	200	122	1500	9.99E-06	NA	1
Chrysene			5	117	1.67E+10	225	200	122	1500	3.02E-15	1.00E-06	NA
ChromiumVI												
Lead												

Chemical	TR (carc)	HI (nonc)	BWadult	AT	SFi (carc)	RfD (nonc)	IR air	EF	ED	RBSLair	H	RBSLwater
			kg	yr	(mg/kg-day)⁻¹	(mg/kg-day)	m³/day	day/yr	yr	mg/m³	cm³/cm³	mg/L
Benzene	1.00E-06	NA	70	70	2.90E-02	NA	20	90	1	3.43E-02	2.26E-01	0.15
Toluene	NA	1	70	1	NA	1.14E-01	20	90	1	1.62E+00	3.01E-01	5.38
Ethylbenzene	NA	1	70	1	NA	2.86E-01	20	90	1	4.06E+00	2.80E-01	14.50
Xylenes	NA	1	70	1	NA	NA*	20	90	1	NA*	2.78E-01	NA*
Naphthalene	NA	1	70	1	NA	3.71E-04	20	90	1	5.27E-03	2.00E-03	2.63
MTBE	NA	1	70	1	NA	8.60E-01	20	90	1	1.22E+01	4.16E-02	293.443
Chrysene	1.00E-06	NA	70	70	1.46E-02	NA	20	90	1	5.81E-02	3.02E-18	2.25E+16
Chromium VI												NA*
Lead												NA*

*No inhalation reference dose is available for xylenes, chromium, or lead; therefore, no RBSLs can be calculated.

Prepared By Greg Swanson

Reviewed By

Minimum Construction Worker RBSLs

	Dermal RBSL mg/L	Incidental Ingestion RBSL mg/L	Inhalation RBSL mg/L	Minimum RBSL mg/L
Benzene	0.85	68.52	0.15	0.15
Toluene	23.98	5,677.78	5.38	5.38
Ethylbenzene	6.05	2,838.89	14.50	6.05
Xylene	102.33	56,777.78	NA*	102.33
Naphthalene	1.63	1,135.56	2.63	1.63
MTBE	25.92	141.94	293.44	25.92
Chrysene	0.32	272.22	2.25E+16	0.32
Chromium VI	2.37	1.00	NA	2.37
Lead	NA	NA	NA	NA

NA = Not Available

Prepared By: Greg Swanson (Cly M. Hoyt)

Reviewed By:

SITE 27, BUILDING 221, ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 10-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{source}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{comp}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{comp} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{oc} = Fraction Organic Carbon in Soil	g-C/g-soil
α_x = Longitudinal Dispersivity = x/10	m
α_y = Transverse Dispersivity = $\alpha_x/3$	m
α_z = Vertical Dispersivity = $\alpha_y/20$	m
k_{oc} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_d = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_c = Constituent Retardation Factor	
V/R_c = Maximum Transport Rate of Dissolved Constituent = $(K_s i)/(\theta R_c)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_s m/sec	i m/m	θ m^3/c	ρ_s g/cm^3	α_x m	α_y m	α_z m	f_{oc} g-C/g-soil	k_{oc} cm^3-H_2O/g-C	k_d cm^3-H_2O/g-soil	V m/sec	R_c	C_{POE}/C_{source}
Naphthalene	65	19.81224	15	2	3.15E+08	1.17E-04	0.0124	0.47	1.45	1.98	0.66	0.10	1.75E-03	1543	2.70026	3.08E-06	8.331	5.992E-01
Lead	420	128.0176	15	2	3.15E+08	1.17E-04	0.0124	0.47	1.45	12.80	4.27	0.64	1.75E-03	0	0	3.08E-06	1.000	2.229E-02
Total Chromium	51	15.54499	15	2	3.15E+08	1.17E-04	0.0124	0.47	1.45	1.55	0.52	0.08	1.75E-03	0	0	3.08E-06	1.000	7.523E-01

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*. Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_c}\right)}{2\sqrt{\alpha_x \frac{vt}{R_c}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_z x}}\right]$$

Constituent	C_{source} mg/L	C_X mg/L	RBSL mg/L
Naphthalene	0.017	0.010	0.010
Lead	0.675	0.015	0.015
Total Chromium	0.133	0.100	0.100

Prepared By: Greg Sorenson (Greg M. Sorenson)

Reviewed By:

SITE 27, BUILDING 221, ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted 20-year Migration of Constituents in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
I = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{OC} = Fraction Organic Carbon in Soil	g-C/g-soil
α_x = Longitudinal Dispersivity = x/10	m
α_y = Transverse Dispersivity = $\alpha_x/3$	m
α_z = Vertical Dispersivity = $\alpha_x/20$	m
k_{OC} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s I)/(\theta R_C)$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_s m/sec	I m/m	θ m^3/a	ρ_s g/cm^3	α_x m	α_y m	α_z m	f_{OC} g-C/g-soil	k_{OC} cm^3-H_2O/g-C	k_D cm^3-H_2O/g-soil	V m/sec	R_C	C_{POE}/C_{SOURCE}
Naphthalene	65	19.8122	15	2	6.31E+08	1.17E-04	0.0124	0.47	1.45	1.98	0.66	###	1.75E-03	1543	2.70025	3.08E-06	9.331	5.892E-01
Lead	425	129.542	15	2	6.31E+08	1.17E-04	0.0124	0.47	1.45	12.95	4.32	###	1.75E-03	0	0	3.08E-06	1.000	2.177E-02
Total Chromium	51	15.545	15	2	6.31E+08	1.17E-04	0.0124	0.47	1.45	1.55	0.52	###	1.75E-03	0	0	3.08E-06	1.000	7.523E-01

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_C}\right)}{2\sqrt{\alpha_x \frac{vt}{R_C}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_z x}}\right]$$

Constituent	C_{SOURCE} mg/L	C_X mg/L	RBSL mg/L
Naphthalene	0.017	0.010	0.010
Lead	0.675	0.015	0.015
Total Chromium	0.133	0.100	0.100

Prepared By: Greg Swanson

Reviewed By:

SITE 27, BUILDING 221, ZONE E, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

DOMENICO'S DILUTION/ATTENUATION EQUATION FOR GROUNDWATER TRANSPORT

Predicted Time Period to Reach Equilibrium in Groundwater

Parameter Descriptions:	Units
POE = Point of Exposure	
SSTL = Site-Specific Target Level	mg/L
$SSTL_{SOURCE}$ = Hydrocarbon Concentration in Plume Source Area protective of RBSLs at POE	mg/L
$SSTL_{COMP}$ = Hydrocarbon Concentration at Compliance Point protective of RBSLs at POE	mg/L
X_{POE} = x = Distance from Plume Source to POE (along Centerline)	m
X_{COMP} = x = Distance from POE to Compliance Point (along Centerline)	m
Y = Source Width (Perpendicular to Flow Direction)	m
Z = Source Depth (Perpendicular to Flow Direction in Vertical Plane)	m
K_s = Saturated Hydraulic Conductivity	m/sec
i = Groundwater Gradient	cm/cm
θ = Porosity in Saturated Zone	cm^3/cm^3

Parameter Descriptions:	Units
ρ_s = Soil Bulk Density	g/cm^3
f_{OC} = Fraction Organic Carbon in Soil	g-C/g-soil
α_x = Longitudinal Dispersivity = x/10	m
α_y = Transverse Dispersivity = $\alpha_x/3$	m
α_z = Vertical Dispersivity = $\alpha_x/20$	m
k_{OC} = Organic Carbon Partition Coefficient	cm^3-H_2O/g-C
k_D = Soil-Water Sorption Coefficient	cm^3-H_2O/g-soil
V = Pore Water Velocity	m/sec
R_C = Constituent Retardation Factor	
V/R_C = Maximum Transport Rate of Dissolved Constituent = $(K_s i)/(\theta f_{OC})$	m/sec
RBSL = Risk-Based Screening Level in Water Provided by SCDHEC (1998)	mg/L

Dilution & Attenuation without Biological Decay

Constituent	X_{POE} ft	X_{POE} m	Y m	Z m	t sec	K_s m/sec	i m/m	θ m^3/o	ρ_s g/cm^3	α_x m	α_y m	α_z m	f_{OC} g-C/g-soil	k_{OC} cm^3-H_2O/g-C	k_D cm^3-H_2O/g-soil	V m/sec	R_C	C_{POE}/C_{SOURCE}
Naphthalene	65	19.8122	15	2	1.23E+08	1.17E-04	0.0124	0.47	1.45	1.98	0.66	###	1.75E-03	1543	2.70025	3.08E-06	9.331	5.582E-01
Lead	425	129.542	15	2	1.10E+08	1.17E-04	0.0124	0.47	1.45	12.95	4.32	###	1.75E-03	0	0	3.08E-06	1.000	2.150E-02
Total Chromium	51	15.545	15	2	1.50E+07	1.17E-04	0.0124	0.47	1.45	1.55	0.52	###	1.75E-03	0	0	3.08E-06	1.000	7.483E-01

Source: South Carolina Department of Health and Environmental Control (SCDHEC) 1998. *Risk-Based Corrective Action for Petroleum Releases*, Bureau of Underground Storage Tank Management.

DOMENICO DILUTION/ATTENUATION MODEL WITHOUT BIOLOGICAL DECAY

$$\frac{C_X}{C_{SOURCE}} = \frac{1}{2} erfc\left[\frac{\left(x - \frac{vt}{R_C}\right)}{2\sqrt{\alpha_x \frac{vt}{R_C}}}\right] \times erf\left[\frac{Y}{4\sqrt{\alpha_y x}}\right] \times erf\left[\frac{Z}{2\sqrt{\alpha_z x}}\right]$$

Constituent	C_{source} mg/L	C_X mg/L	RBSL mg/L
Naphthalene	0.017	0.010	0.010
Lead	0.675	0.015	0.015
Total Chromium	0.133	0.100	0.100

Time to Steady State years
3.9
3.5
0.8

Prepared By: Greg Swanson (by M. Duff)

Reviewed By:

STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

"Better Service for a Better Environment"

HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973

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RUSSELL J. HARDING, Director

REPLY TO:

ENVIRONMENTAL RESPONSE DIVIS.
KNAPPS CENTRE
PO BOX 30426
LANSING MI 48909-7926

May 28, 1999

TO: Interested Parties

FROM: Alan J. Howard, Chief, Environmental Response Division (ERD)

SUBJECT: Revised Part 201 Operational Memorandum #18 Cleanup Criteria Tables

Attached are the revised Part 201 Operational Memorandum #18 (Op Memo #18) cleanup criteria tables and footnotes. Preceding the tables is a list of criteria changes. Replace the January 1999 criteria tables and footnotes in your hard copy of Op Memo #18 with the attached criteria tables, the footnotes, and the list of changes. The original text and Attachment B of Op Memo #18 have not changed. The revised materials are also available on the Internet via the Environmental Response Division (ERD) homepage (http://www.deq.state.mi.us/erd).

The list of changes preceding the tables is a list of hazardous substances for which criteria have changed since the January 1999 version of Op Memo #18. If the hazardous substances on the list are of interest to you, the actual values can be obtained from the tables. We will continue to provide this listing in future revisions of the criteria tables, which are scheduled every four months. Mark on your calendars that the next published revisions are scheduled for September of this year. Finalization and publication of the Op Memo #18 criteria tables and the Part 201 Training Material Criteria Tables will be synchronized. Any criteria that become available or are revised between the scheduled updates will not be considered official or final until the next publication of the criteria tables. However, anyone inquiring about new or revised criteria prior to finalization/publication of those criteria will be informed of the impending changes. These criteria will be considered draft until published. Decisions related to specific facilities can be made with the draft criteria in mind.

Questions related to the cleanup criteria can be directed to ERD's Toxicology Unit at 517-241-7651.

Attachments

cc: Flint Watt, DWRPD
Harold Fitch, GSD
Paul Zugger, Acting Chief, STD
Jim Sygo, WMD

ATTACHMENT A
GROUNDWATER: RESIDENTIAL AND INDUSTRIAL-COMMERCIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS

Chemical	Chemical Abstract Service Number	#1 Residential & Commercial I Drinking Water Criteria	#2 Industrial & Commercial II, III & IV Drinking Water Criteria	#3 Groundwater Surface Water Interface Criteria	#4 Residential & Commercial I Groundwater Volatilization to Indoor Air Inhalation Criteria	#5 Industrial & Commercial II, III & IV Groundwater Volatilization to Indoor Air Inhalation Criteria	#6 Groundwater Contact Criteria (AA)	#7 Water Solubility	#8 Flammability and Explosivity Screening Level	#9 Acute Inhalation Screening Level
Formaldehyde	50000	1,300	3,800	120	63,000	3.6E+5	2.9E+7	5.50E+8	ID	61,000
Formic acid (I,U)	64186	18,000 (M)	29,000	ID	7.7E+6	1.5E+7	6.2E+8	1.0E+9	6.6E+8	3.5E+8
1-Formylpiperidine	2591868	80	230	NA	ID	ID	ID	NA	ID	ID
Gentian violet	548629	8.5	35	NA	NLV	NLV	4.9E+5	1.00E+6	ID	ID
Glyphosate	1071836	700 (A)	700 (A)	NA	NLV	NLV	ID	1.16E+7	ID	ID
Heptachlor	76448	0.4 (A)	0.4 (A)	NA	180 (S)	180 (S)	0.71	180	ID	ID
Heptachlor epoxide	1024573	0.2 (A)	0.2 (A)	NA	NLV	NLV	3.1	200	ID	ID
n-Heptane (I)	142825	32,000	92,000	NA	2,700 (S)	2,700 (S)	2,700 (S)	2,690	100	2,700 (S)
Hexabromobenzene	87821	10 (M)	10 (M)	ID	ID	ID	10 (M)	0.17	ID	ID
Hexachlorobenzene (C-66)	118741	1.0 (A)	1.0 (A)	ID	440	3,000	2.0	6,200	ID	ID
Hexachlorobutadiene (C-46)	87683	11	45	ID	1,600	3,200 (S)	200	3,230	ID	ID
alpha-Hexachlorocyclohexane	319846	0.14	0.55	NA	2,000 (S)	2,000 (S)	16	2,000	ID	ID
beta-Hexachlorocyclohexane	319857	0.47	1.9	NA	NLV	NLV	54	240	ID	ID
Hexachlorocyclopentadiene (C-56)	77474	50 (A)	50 (A)	ID	ID	ID	1,400	1,800	ID	ID
Hexachloroethane	67721	61	250	6.7 (X)	27,000	50,000 (S)	1,500	50,000	ID	ID
n-Hexane (I)	110543	3,000	8,600	NA	12,000 (S)	12,000 (S)	12,000 (S)	12,000	12,000 (S)	ID
2-Hexanone (I)	591786	1,000	2,900	NA	4.2E+6	8.8E+6	4.8E+6	1.60E+7	ID	ID
Indeno(1,2,3-cd)pyrene (Q)	193395	5.0 (M)	5.0 (M)	ID	NLV	NLV	5.0 (M)	0.022	ID	ID
Iron (B)	7439896	300 (E)	300 (E)	NA	NLV	NLV	ID	NA	ID	ID
Isobutyl alcohol (I)	78831	2,300	6,700	NA	7.6E+7 (S)	7.6E+7 (S)	2.4E+7	7.60E+7	ID	ID
Isophorone	78591	900	3,700	570 (X)	NLV	NLV	1.1E+6	1.20E+7	ID	1.2E+7 (S)
Isopropyl alcohol (I)	67630	470	1,300	NA	NLV	NLV	1.3E+7	1.0E+9	3.0E+7	1.0E+9 (D)
Isopropyl benzene (I)	98828	800	2,300	ID	56,000 (S)	56,000 (S)	56,000 (S)	56,000	15,000	ID
Lead (B)	7439921	4.0 (L)	4.0 (L)	(G,X)	NLV	NLV	ID	NA	ID	ID
Lindane	58899	0.2 (A)	0.2 (A)	0.027	ID	ID	86	6,800	ID	ID
Lithium (B)	7439932	170	350	25	NLV	NLV	8.0E+6	NA	ID	ID
Magnesium (B)	7439954	4.2E+5	1.2E+6	NA	NLV	NLV	1.0E+9 (D)	NA	ID	ID

FOOTNOTES

{A} Criterion is the State of Michigan Drinking Water Standard established pursuant to Section 5 of the Safe Drinking Water Act, Act No. 399 of the Public Acts of 1976.

{B} Background, as defined in Rule 299.5701(c), may be substituted if higher than the calculated cleanup criteria. Background levels may not exceed criteria for all inorganic compounds.

{C} Value presented is a screening level based on the chemical-specific generic soil saturation concentration (Csat) since the calculated risk-based criterion is greater than Csat. Concentrations greater than Csat are acceptable cleanup criteria for this pathway where a site-specific demonstration indicates that free-phase contaminant is not present. Consult the Generic Soil Saturation Concentrations: Technical Support Document (August 31, 1998) for further guidance on development of site-specific Csat values. Risk-based criteria are available by contacting an ERD toxicologist.

{D} Calculated criterion exceeds 100%, hence it is reduced to 100% (i.e., 1.0E+9 ppb). Evaluation of free phase contaminant, environmental impacts, adverse aesthetics and acute or local toxicity is required.

{E} Criterion is the aesthetic drinking water value, as required by Sec. 20120(1)(5).

{F} Criterion is based on adverse impacts to plant life (i.e., phytotoxicity).

{G} GSI value is pH or water hardness dependent. The Final Chronic Value (FCV) for the protection of aquatic life must be calculated based on the pH or hardness of the receiving surface water. Where water hardness exceeds 400 mg $CaCO_3$/L, use 400 mg $CaCO_3$/L for the FCV calculation. The FCV formula provides values in units of ug/L (ppb). The dissolved to total metal translator (T) is used to convert from a dissolved to a total FCV value. The generic GSI criterion is the lesser of the calculated FCV, the wildlife value (WV) and the surface water human non-drinking water value (HNDV). For these chemicals, the soil GSI protection criteria will be based on the final generic GSI criterion determined by the process described in this footnote. Contact an ERD toxicologist for further guidance.

Chemical	FCV Formula ug/L	FCV Conversion Factor (CF)	Dissolved to Total Metal Translator (T)	WV ug/L	HNDV ug/L
Beryllium	EXP(2.5279*(LnH)-10.7689)	NA	NA	NA	1,200
Cadmium	((EXP(0.7852*(LnH)-2.715))*CF(Cd))*T	CF(Cd) = 1.10167-[(LnH)*(0.04184)]	2.1	NA	130
Chromium (III)	((EXP(0.819*(LnH)+0.6848))*0.86)*T	NA	1.5	NA	9,400
Copper	((EXP(0.8545*(LnH)-1.702))*0.96)*T	NA	1.5	NA	64,000
Lead	((EXP(1.273*(LnH)-3.296))*CF(Pb))*T	CF(Pb) = 1.46203-[(LnH)*(0.14571)]	4.5	NA	190
Manganese	EXP(0.859*(LnH)+1.957)	NA	NA	NA	59,000
Nickel	((EXP(0.846*(LnH)+0.0584))*0.997)*T	NA	$1+(0.49*(SS)^{0.4281})$	NA	2.1E+5
Pentachlorophenol	EXP(1.005*(pH)-5.134)	NA	NA	NA	2.8
Zinc	((EXP(0.8473*(LnH)+0.884))*0.986)*T	NA	2.1	NA	22,000

Where,

EXP(x) = The base of the natural logarithm raised to power x (e^x).
LnH = The natural logarithm of water hardness in mg $CaCO_3$/L.
SS = Total suspended solids in mg/L
* = The multiplication symbol.

{H} Valence-specific chromium data (Cr III and Cr VI) must be compared to the corresponding valence-specific cleanup criteria. If analytical data are provided for "total" chromium only, then values for Cr VI must be applied as the cleanup criteria. Cr III cleanup criterion for protection of drinking water can only be used at sites where groundwater is prevented from being used as a public water supply, currently and in the future.

{I} Chemical may exhibit the characteristic of ignitability as defined in 40 CFR 261.21. Contact an ERD toxicologist for further direction.